SCIENTIFIC AMERICAN

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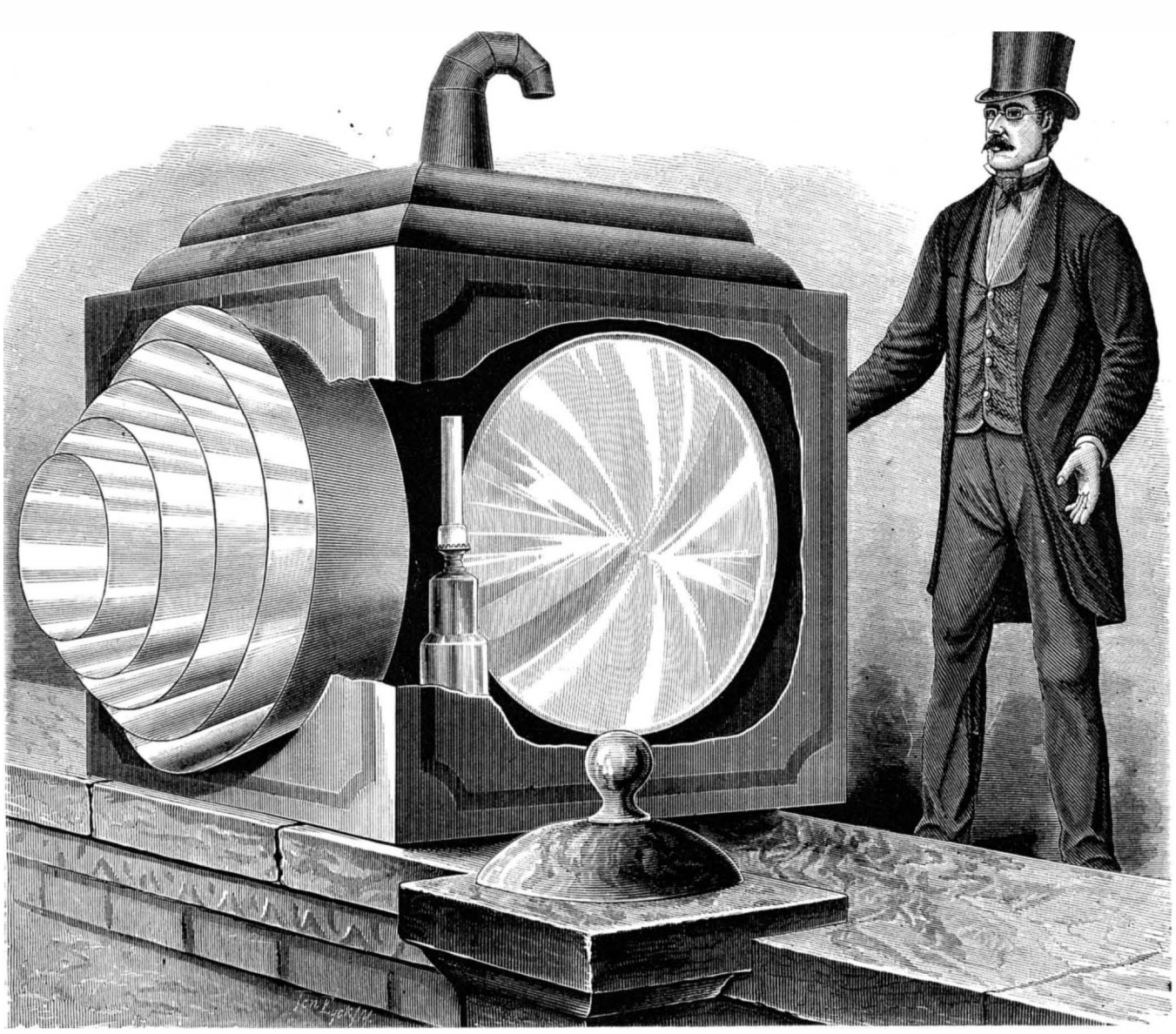
NEW SYSTEM OF ILLUMINATION BY REFLECTION.

In order to collect rays of radiant light or heat, two means are now used, based, the one on reflection by bright surfaces, the other on the refractive power of suitable lenses. Theoretically, reflection alone has an indefinite application, since recourse may be had to plane mirrors movable in all directions, the rays reflected from which may be converged on a determined point: or to concave mirrors. The practical employment of these last is however impeded by difficulties of fabrication.

In the case of refraction, such as takes place through the lenticular apparatus of lighthouses, for example, a variety of disadvantages exist. There is a large sbsorption of light by the glass, double reflection at the two surfaces of the refracting medium, dispersion due to *striæ* and bubbles, and finally the double aberration of sphericity and refrangibility of the spherical glasses which form the principal part and often the entirety of the apparatus.

It will be seen, therefore, that, in order to obtain best results, a construction is needed which will combine all the advantages of the reflecting system, while eliminating the capital difficulties in fabrication, difficulties which are directly proportional to dimensions, and consequently diminish the use ful effect of the reflector. Such is the problem which, it appears, has been successfully solved by Professor Balestrieri, of Naples, by the invention of the photothermic hollow sphere collector (*collecteur photo-thermique armillaire*), the principle of which we will now explain by the aid of the annexed diagrams.



BALESTRIERI'S SYSTEM OF ILLUMINATION.

A C and A B, in Fig. 2, are indefinite lines, placed at right angles, and divided from A into a certain number of equal

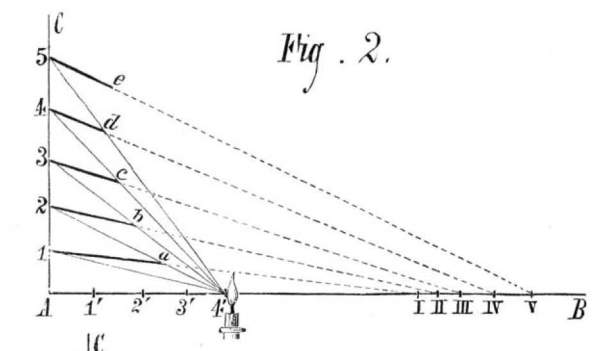


Fig. 2.

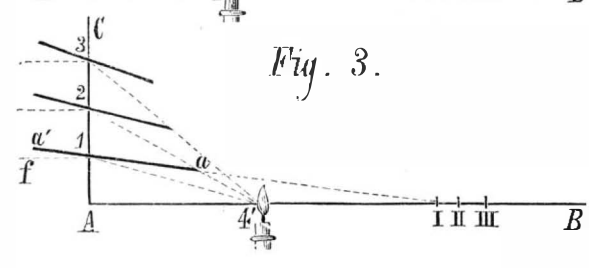


Fig. 3.

parts, 1, 2, 3, 1′, 2′, 3′, etc. Take any point on the line, A B, for example 4′, for the focus of the system, and draw therefrom the lines 4′ 1, 4′ 2, etc. These lines represent rays from focus 4′. From 4′ on the line, A B, set off 4′ I equal to 4′ 1, 4′ II equal to 4′ 2. etc., and then join, by dotted lines, the points I, II, III, IV, V, with 1, 2, 3, 4, 5, on line, A C. Then these lines, 1 I, 2 II, etc., when the line, A C, is revolved about A B as an axis, will describe surfaces of right cones; and the portions of said dotted lines comprised between the successive rays (made full lines in the engraving) will be superior profiles of segments of these cones on the base.

Suppose now that these profiles 1 *a*, 2 *b*, 3 *c*, etc., represent metallic segments with polished surfaces. The ray of light, 4 1, Fig. 3, impinges on the surface or annulet, 1*a*, at the point, 1, and will be reflected to *f*. Now as 4 1 = 4 I in the triangle 4 1 I, the angle 4 I 1 = 4 1 I. Moreover the angle of incidence, 4 1 *a* = the angle of reflection, *f* 1 *a*′. Hence the reflected ray, *f* 1, is parallel to A B. Similarly it may be demonstrated that all the other reflected rays will be parallel to the same axis, and consequently the beam of reflected light will be composed of parallel rays,

Fig. 4 represents a section of an assemblage of these reflecting segments of cones, to which the inventor has given the name *armilles* (annulets), and which together compose a collector. The sphere of light emanating from the central source may be supposed to be divided into two hemispheres by the line, P. The rays of the anterior hemisphere are collected and reflected by the segments, 1 *a*, etc., and the quantity of collected rays is indicated by the arc, *w z*. It is equally possible to collect and utilize the rays of the posterior hemisphere, and to this end is arranged the concave mirror, M, the center of curvature of which is at O. The rays from the luminous source, impinging upon the mirror at *r r*′, are projected on the lines, R *r*, R′ *r*′, through the spaces between the segments. Each part of said space through which the rays pass equals one half the distance, 1 2; consequently the reflector adds to the light collected by the segments one half of all that which falls upon its surface. If therefore the segments collect 150° of light, the mirror will collect 75°, and therefore the sum 225° will represent the portion of the luminous sphere utilized.

For lighthouses, at the present time the Fresnel lens is largely employed; but this is subject to the disadvantages already noted as peculiar to refractive apparatus. Moreover, with all lenses, no two rays are truly parallel, and the projection of the light at a distance causes a conjugate focus, which is in relation to the luminous object of which it is an enlarged image. With Professor Balestrieri's device, there is no image, no conjugate focus. In each segment there exists a circular section which reflects the rays from the luminous focus rigorously parallel. The other points of the segment reflect rays slightly divergent or convergent; each of the other points of the flame likewise gives some rays parallel, the rest not so; and the latter, after crossing, diverge in their turn. Thus innumerable parallel and diverging rays are produced, which combine to form a luminous cone, the base of which is projected in space. Thus the size of the flame is a first element of divergence, and the same is true of the segments: the larger they are, the greater is the divergence. Instead of arranging the segments on a plane, they may be disposed on a curve so as to collect the entire 180° of light of the anterior hemisphere.

No lens can have an opening, A B, Fig. 5 (page 375), greater than its radius of curvature, O C, on account of difficulties in fabrication and of the total angle of reflection of the glass. The angle, A C B, of this opening is but 60°. Now as the principal focus, F, of a plano-convex lens, is very nearly at the extremity of the diameter of the sphere, O F, it follows that the lens cannot collect more than 30° of light. In the construction of lighthouses, this large focal distance is a serious inconvenience, in addition to that due to the small collecting angle. In the case, for example, of a flash light, for lenses of 1 meter, turning around a lamp, C (Fig. 5), O C + C F would be equal to 2 meters, and consequently the circumference about which the lens must travel would be 12·56 meters, or about 40 feet. As the flashes must be rapidly repeated, it follows that, in passing over so long a road, lenses must be multiplied, and therefore it happens that 10 or 12 of the latter are often found in a single lighthouse.

In Professor Balestrieri's apparatus the focal point is arbitrary, and the segments can be adjusted to suit it at any position, to give, say, a focal distance of 19½ inches or even less. The circular travel would be but 5 feet, and a single

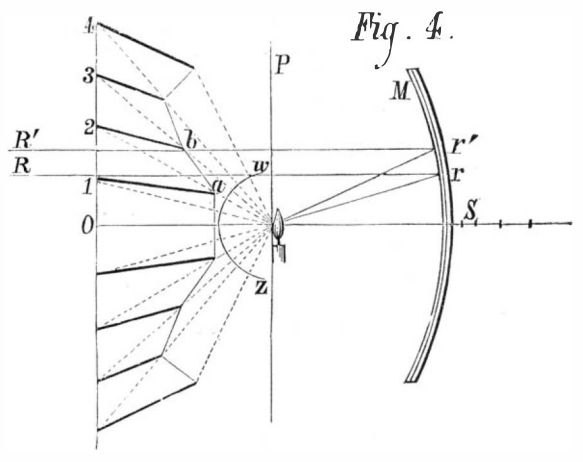


Fig. 4.

set of segments, or at most two, would replace the dozen lenticular systems, besides affording a greater simplicity and much greater economy in construction.

The apparatus, we learn from *Les Mondes*, from which journal we condense the present article, has been subjected

(*Continued on page* 372.)

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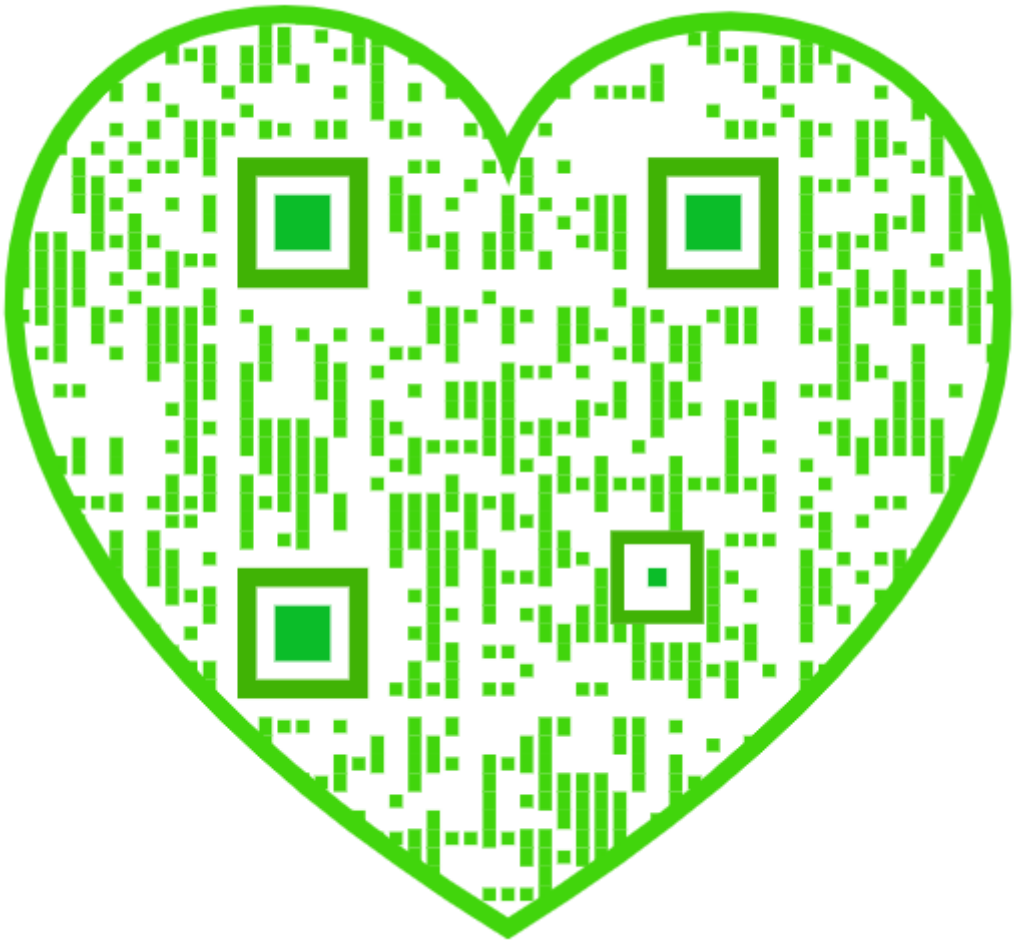

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Imitation Silver on Stone and Plaster.

Take two sheets of mica, and render them perfectly white by boiling in hydrochloric acid, or by the action of fire. Wash and dry, and then bruise them to fine powder, which sift. Mix the powder with very light collodion; and with a soft camel's hair brush, put two or three layers on the object. This coating, as soon as dry, will assume and preserve the appearance of silver.

SPONTANEOUS COMBUSTION.

We noted, recently, a case of spontaneous combustion due to the saturation of sawdust and shavings by boiled linseed oil. The refuse had accumulated under the floor of a carpenter's shop, through cracks in which the oil had leaked, and the first intimation which the occupant of the premises had of his impending danger was a thin wreath of smoke oozing up between the boards. Instances of this kind are exceedingly common; so common, indeed, that it may be fairly believed that a very large proportion of the fires, the immediate causes of which frequently baffle all attempts at discovery, arise from the flame thus insidiously generated. A case lately happened within our own knowledge, where a gentleman, who had left his house for a brief period unoccupied, returned late at night to find the building filled with smoke and his kitchen woodwork in a light blaze. Prompt measures luckily resulted in extinguishment of the fire; and on investigation it was found that a servant had employed a closet shelf as a receptacle for old greasy dishcloths and oily rags used for cleaning furniture. The ignition of such materials, always favored by a slight warmth, was hastened by the temperature of the kitchen, and the rapid oxidation soon determined active combustion.

It has been determined by experiment that a handful of cotton waste soaked in boiled linseed oil, placed in a chamber at a temperature of 170° Fah., will take fire in less than two hours. If raw linseed oil be used, the time occupied is from four to five hours, and with rape oil about six hours. Gallipoli oil takes about the time last mentioned, under 132° Fah. Castor oil, under like circumstances, is very slow; and at the end of two days, waste saturated with it only became a mass of charred cotton. Lard oil produces rapid combustion in about four hours. Sperm oil, on the other hand, refuses even to cause a charring of the waste. Seal oil, of a strong fish odor not unlike sperm, has produced rapid ignition in one hundred minutes, temperatures being as last stated. The heavy oils from coal and shale, being chiefly the higher olefines, have a remarkable effect in preventing oxidation, through giving a certain protection from the air. Mixtures of these oils with 20 per cent of rape oil gave no indication of heat whatever at 170° Fah.; and even seal oil, with its own bulk of mineral oil added to it, did not at 135° reach a temperature sufficient to char cotton.

As a general rule, it may be laid down that spontaneous combustion of refuse, soaked with vegetable or animal oils, will occur whenever the conditions are such that a temperature of at least 175° continues for several hours. Cotton will burst into flame; wool, on the other hand, becomes a blackened mass. Equal weights of cotton and oil produce the most rapid inflammation. Combustion may be checked or stopped by the addition of mineral oil. Wherever vegetable or animal oil (other than sperm) is largely used, therefore, whether for lubricating machinery or oiling tissues, it would seem to be a safe precaution to add to it as large a proportion of mineral oil as possible, if such addition can be made without interfering with the use of the material.

WHAT IS BAD WATER?

There has recently been some complaint in this city regarding the condition of the Croton water, which has appeared muddy in color, owing to its being slightly charged with organic and other substances. As the Croton is normally of exceptional purity and clearness, the presence of the foreign matter excites attention which would not be accorded it were we accustomed to drinking such water as is consumed from the Thames river in England, or from the Mississippi or Monongahela rivers in this country, where muddiness is rather the rule than the exception. In New York, however, we have the satisfaction of knowing that our water supply is undefiled. No town or factory refuse passes into it; and therefore it is reasonably certain that such impurities as may affect it are those due to natural causes, and not to the addition of extraneous matter which may be deleterious to health. But this is not the case everywhere; and in localities where the supply is taken from adjacent rivers and streams which pass through populous districts, any change in the water may bode its pollution to a degree which renders it unfit for human consumption; and indeed, the same result may happen without the water visibly indicating the fact, save by its effects. This trouble has been found seriously to exist in England; and for several years the subject of the river pollution, which is a necessary consequence of the closely settled country and its immense manufacturing districts, has been under examination by government commissions of scientific men.

Among other objects of the investigation has been that of determining what bad water is, or rather at what point, whether through mechanical or chemical impurities, pollution of the liquid may be considered as beginning. In a recent report, Professor Frankland answers the question of what a polluted liquid is as follows:

(1) Every liquid which has not been submitted to precipitation produced by a perfect repose in reservoirs of sufficient dimensions during a period of at least six hours; or which, having been submitted to precipitation, contains in suspension more than 1 part by weight of dry organic matter in 100,000 parts of liquid; or which, not having been submitted to precipitation, contains in suspension more than 3 parts by weight of dry mineral matter, or 1 part by weight of dry organic matter, in 100,000 parts of liquid. (2) Every liquid containing in solution more than 2 parts by weight of organic carbon or 3 parts of organic nitrogen in 100,000 parts of liquid. (3) Every liquid which, when placed in a white porcelain vessel to the depth of one inch, exhibits under daylight a distinct color. (4) Every liquid which contains in solution, in every 100,000 parts by weight, more than 2 parts of any metal, except calcium, magnesium, potassium, and sodium. (5) Every liquid which, in every 100,000 parts by weight, contains, in solution, suspension, chemical combination, or otherwise, more than 0·5 of metallic arsenic. (6) Every liquid which, after the addition of sulphuric acid, contains in every 100,000 parts by weight more than 1 part of free chlorine. (7) Every liquid which, in every 100,000 parts by weight, contains more than 1 part of sulphur, in the state of sulphuretted hydrogen or of a soluble sulphuret. (8) Every liquid having an acidity superior to that produced by adding 2 parts by weight of hydrochloric acid to 1,000 parts of distilled water. (9) Every liquid having an alkalinity greater than that produced by adding 1 part by weight of caustic soda to 1,000 parts of distilled water. (10) Every liquid exhibiting on its surface a film of petroleum or hydrocarbon, or containing in suspension, in 100,000 parts, more than 0·05 of such oils.

By the aid of the above, it is easy to determine what streams are polluted and what pure; and when the feeders to the source whence the water supply is obtained are found to be thus contaminated, it becomes a question for the authorities to determine as to the necessary restrictive measures to prevent the continuance of the evil. Of course, a stream cannot be regarded as polluting when, although containing deleterious ingredients in a greater degree than is above laid down, it empties into a source of water supply which is even fouler: so that the question of whether a stream is a means of pollution. and hence a public nuisance, is one of a relative nature, depending on individual circumstances.

A SOCIAL PERIL.

The confession of the Boston belfry murderer, Piper, reveals an instance of a mental condition, the evil results of which seemingly defy any preventive measures that society can devise. It shows us that we have to face a new danger, more insidious and more terrible than are magazines of dangerous explosives located in our midst. We can recognize symptoms of lunacy and put the sufferer under restraint: if not before, at least immediately after he has slaughtered one fellow being; but what are we to do with those who exhibit no symptom of mental alienation, but who kill again and again for the love of killing? Unlike the lunatic who makes no effort to hide the crime, or the assassin who in his cooler moments betrays the work done in the heat of passion, these wretches are destitute even of a twinge of remorse, and their covering of the deed is performed with a coolness and thoroughness to which the murderer for greed or revenge is a stranger.

This man, Piper, confessed to have killed two victims, not because he was impelled to do so by any ungovernable impulse, but for a clear motive of self-gratification; he liked "to see them suffer." It appears that the very heinousness of the crimes has caused the idea that the perpetrator was in sane, and should not have suffered the death penalty, a notion we think unfounded and fraught with great mischief to society. There is the clearest possible distinction between the case of Piper and of a man who kills through morbid impulse. True morbid impulse, for example, impels a man to lie in wait for and to murder the person who his diseased deliri ous imagination supposes is about to do him some terrible injury. He is perfectly aware of his wrong-doing, but is so impelled to its perpetration that he cannot avoid it. Now, on the other hand, if while in a delirious state he should act according to his reason, no matter how perverted, and then strike down his victim, there is no morbid impulse; nor would there be any, should he commit suicide to avoid some imaginary impending calamity. Note the distinction which is here thus closely drawn: it lies simply in the fact that the murderer is irresistibly impelled to the deed. He does it not merely because he thinks it expedient for his safety, but because he *must* do it.

Now, in this Boston case, morbid impulse is obviously wanting, although it has been predicated on the apparent absence of motive to the crimes. Here is again an error; for there was a motive of the strongest possible description, namely, that of the love of killing; the same motive which induces a brute to slay its natural prey in infinitely greater numbers than are required for its food, and identically the same passion which, in a less dangerous form, finds its gratification in the combats of gladiators or the deadly fights of animals. It is as easy to imagine that such a passion might gain an ascendency as well as the passion for drink, or any other of those which civilization endeavors to curb and repress. There is no insanity in the case, any more than there is in that of the drunkard or the gambler whom the law looks upon as perfectly responsible for his actions.

The vital question, however, is: How is society to protect itself against this evil? Necessity points to the prompt extermination of those affected with the killing lust wherever detected. Reformatory measures seem unavailing; for who can say that, by preventing a person killing his fellows for a certain time, or by submitting him to a certain treatment, a desire which has almost become an instinct will be obliterated? In any event, while society can afford to risk the relapses of a thief, it cannot those of a murderer; nor can it, by immuring him for life, risk the possibility of future mistaken leniency in the shape of a pardon. This, however, only disposes of those persons actually detected, and prevents their subsequent crimes only. How to protect ourselves, against affected persons whose murderous disposition has not actually been manifested, is a problem which must be solved by eradicating such sources of moral contagion as we know to exist.

Despine, the celebrated French psychologist, records that, during the first empire, a soldier hanged himself in his sen-

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try box; soon after, other soldiers did the same, and, until the curious expedient of destroying all the sentry boxes was thought of, the contagion remained active. The same observer points out the epidemic character, at one period, of duelling; and it is well known that, so frequent are suicides from particular high monuments, that especial means are there needed to prevent the crime. Despine considers this due to a moral influence. Bouchut, on the other hand, considers the mechanism of disturbance an external "miasmatic influence." Richardson, the most recent observer, thinks that the phenomena are connected with disturbance, that is, modified motion in the ethereal matter which, according to his theory, changes the living person's organism throughout its entire extent, and is the medium of communication between ourselves and the outer universe. "Through it different centers of the nervous organism can be excited by external forces as readily as they can be by direct organic injuries."

It remains, then, to discover accurately the causes of the particular disturbance which spreads the contagion of murder. In the Pomeroy case, the relation of the boy to his father's calling as a butcher and slaughterer gives us a possible clue to his murderous propensities; and at the same time, it may be suggested that the contagion spread by that boy's atrocities could easily have affected Piper, and perhaps others similarly disposed, and thus another argument is added to that in favor of the death penalty. From the Pomeroy case, the moral danger existing in habituating a person, and especially a child, to scenes of violent death is evident; and without further instance, it may be laid down as a duty of society to protect its members from the effect of such scenes. This would involve stringent laws, imposing more severe penalties than now exist for prizefighting, against wanton torture, killing and mutilation of brutes, and for mayhem, or like assaults of a peculiarly brutal character, on the person; also measures would be needed tending to the isolation of slaughterhouses and the prevention of public access thereto. It is, furthermore, obvious that the present publicity of the death penalty must in a measure defeat its object, since it is an open example of killing, fully susceptible of breeding moral contagion. Therefore, executions should be performed secretly, and the accounts now published to cater to a depraved taste rendered impossible. At the same time, such shows of murderers' and burglars' weapons as one which has recently disgraced a prominent thoroughfare in this city, together with that foul blot on modern journalism, the sensational sheet of criminal news, should be rigidly suppressed.

This much, and perhaps more which further consideration may suggest, society may do. But after all, the principal measures lie in the hands of parents and instructors. It is for them to repress the first manifestations of an abnormally destructive nature, for during early youth that nature is most clearly exhibited; and it is for them likewise to see to it that such sources of moral contagion as society tolerates shall not influence the plastic and receptive minds of those entrusted to their care.

SUGGESTIONS FOR YOUNG MASTER MECHANICS.

It is a great error for a young workman to suppose, because he has mastered enough of his trade to be considered a good hand, and now contemplates starting for himself, that all he has to do is to hang out a sign and people will thereupon rush to employ him. Every man has got to build up two things, first, his education, second, his business. There is no royal road to either. Because a workman has his trade education, it does not at all follow that he can command trade. True, he may have his reputation, and through it may obtain employment under others with ease; but in starting for himself, he should remember this distinction: that he becomes the servant not of one or of a dozen persons, but of the whole public; and for him to prove to the public, who knows nothing about him at first, that he is worthy of employment, takes time and patience. Now, it is usually the case that the young workman has no large amount of funds wherewith to maintain himself during that period of enforced idleness which must follow before sufficient business for his support is secured by him. To expend that amount in high rent, or in tools other than those absolutely necessary, or for costly fittings to the shop, is excessively fool-hardy and rash. He does not know how long he must wait before his period of independence will arrive, and it is therefore the commonest prudence to husband every resource, under the assumption that that period is a very long time in the future. The best policy, then, is to take a small room, just large enough for the purpose of the work to be done, and for the workman not to attempt anything "in all its branches." We never fancied that addition to a sign on a small shop; in ninety-nine cases out of a hundred, it is a misstatement of the capabilities of its owner. Better begin with the specialty that can be done best, and then, as business increases, add on the branches. Get a reputation established for doing one thing extraordinarily well, and it will go a long way toward extending a business to other affairs when the proper time arrives.

Never slight a job, no matter how small and trivial it may appear. People form estimates of ability from small things very frequently, arguing that a workman who attends to *minutiæ* carefully will be likely to produce more important work complete in all its parts. Besides, the favorable impression conveyed by some little action has laid the foundation of many a man's subsequent future.

Be satisfied with small though just profits. Because you perhaps can do a job a shade better than any one in the vicinity, do not be exorbitant. We heard an unpublished story of the great drygoods merchant, Stewart, recently, which is just to the point here. He said he never took advantage of the market but once, and then he had a large stock of a very superior fabric, not elsewhere found. The temptation was strong to run up the price, and he yielded. Despite the high figures, every yard was sold, and he realized two or three hundred thousand dollars. "I thought this a good bargain at the time," he said, "but I afterwards discovered that it cost me two or three millions. I found that people said: 'Stewart has first class goods, but you've got to pay good prices for them.' It took all my efforts to dispel that impression, and I believe it affected all my future business operations."

We would counsel young workmen to be saving, not only of money but of brains. It is a great deal easier to spend money than to get it, and it is easier to forget than to learn. We have great faith in savings' banks, when they can show a good surplus; and in this respect we would advise working men to avoid those institutions that offer remarkable inducements in the way of interest, and to deposit their funds in banks which pay less but which are firmly established. Thousands of New York workmen had their savings swept away recently by neglecting this precaution. Money at reasonable interest increases wonderfully fast, and nothing can make a man feel more independent of fortune than a neat sum, safely stored away, which can be drawn upon in times of emergency.

To paraphrase a well known axiom, "the price of knowledge is eternal study." The world moves. Because you mastered a subject ten years ago, it does not follow that you know all about it now. A person that expects to keep abreast with the times, and especially one engaged in a mechanical pursuit, in which improvements are constantly made, must read, or fall in the rear. Brains can be saved by reading, just as money can be by putting it in the bank. Study scientific and practical books and papers an hour a day; and the accumulation of money at interest will not be nearly so rapid as the growth of your knowledge. We believe more can be learned in half an hour's intelligent study, followed by a thorough thinking over of the subject, than in six hours' steady application. The study can be done out of working hours; the thinking you can do at the lathe or while performing any job which requires no special skill.

Honor your calling, and it will honor you. It is a thousand times better to be a successful mender of pots and pans than an unsuccessful mender of peoples' bodies; better to be able to draw a straight forging than a bad brief; better be able to compose good mortar than a poor sermon. There are plenty of examples of good workmen becoming great lawyers, and inventors, and senators, and presidents; but very few of poor doctors, or attorneys, or clergymen transforming themselves into anything useful at all. It is a pretty safe rule to believe that, in this world, sooner or later, every man finds his proper level; it is only a question of starting low and working slowly upwards, or starting too high and coming quickly down. The one is usually graceful, the other disgraceful; and there is no human task half so hard as regaining a lost position, nor one in which honest work more often fails to commend success.

DRUGGING HORSES.

We have in a previous article called attention to the barbarous practice of drugging horses in order to put them into apparently good condition. The present is the time of year when this most commonly done, both by those having the animals under their care, or by dealers who find that the effects of spring weather have rendered their horses less sleek and plump, and consequently less salable. It therefore is advisable for those who own horses to see that their stable men do not administer condition powders of their own concoction, however desirable it may be that a tonic of some kind in the spring time be administered; and in buying new stock, it would be as well to let bargains pend for a fortnight or so, in order to afford time for observation whenever the animals show suspicious signs.

There are very excellent veterinary surgeons in this and other cities; but the profession is ridiculously small in numerical strength, as compared to the live stock in the country. The last census states that the total number of surgeons is about 1,100, and there are over 8,000,000 horses and mules. There is 1 skilled cattle doctor to every 7,500 horses; or if we take into consideration other live stock, excluding sheep and swine, the average is as 1 to every 21,655 animals. We adduce these figures simply to show the lack of educated veterinarians, which exists throughout the country, a lack which, as every one knows, is made up by amateur doctoring *ad libitum*. There is nothing so utterly pernicious and unreliable as the work of amateur dabblers at professions; and in this very fact exists the short-sightedness of those who entrust the doctoring of valuable animals to men who are absolutely ignorant of the nature and cause of disease and of the proper scientific treatment to be adopted, and even of the anatomy of the animal. If the carriage breaks down, it is sent to a skilled workman for repairs. No one would listen to the idea of a groom attempting to replace the neat forgings. But when the horses break down, then, in nine cases out of ten, the groom's supposititious knowledge is deemed ample security against his working harm by administering drenches and boluses of fearful and wonderful ingredients. An English agricultural contemporary publishes a letter from a country druggist, which sheds some light on this ignorant system of dosing. One man demanded "condition powders" containing 4 ozs. of tartar emetic. Cream of tartar was meant, and the dispenser gave that harmless substance, otherwise the condition powders would have infallibly killed the patient. Another prescription called for 1 oz. of Spanish flies, a frightfully irritating poison. "Again," adds the writer, "the men somehow obtain enormous quantities of sulphate of zinc (white copperas) and sugar of lead, which they afterwards dissolve in water to use as lotions. The substances lie scattered about the stable shelves, and are carelessly mixed with chopped food or mashes, in mistake for condition powders. When we hear complaints of actual horse poisoning, we wonder how it has been done. There need be no wonder. The local druggist could in most instances throw light upon the case."

It is bad enough to dose sick horses by the rule of thumb; but for the drugging of well animals, there is positively no excuse; and if our societies for the prevention of cruelty to animals would open a vigorous crusade against the system, we probably should hear less of it than we now do. It certainly is just as cruel to cause the animal suffering by doses of cantharides or arsenic as it is to drive it when its neck is galled; and as the officers of societies are empowered by law to prohibit the one, they doubtless are equally empowered to check the other. Meanwhile we suggest to those who possess horses that the present is an excellent time to inspect stables, and to destroy all the bottles of stuff and papers of powder sure to be found on out-of-the-way shelves, and of the uses and nature of which a satisfactory explanation cannot be given.

THE KEELY MOTOR DECEPTION AGAIN.

"When it is considered that machines driven by steam rarely or never create a pressure of over 200 pounds to the square inch, the enormous force of the Keely motor, and its immense capacity for propulsion, can be realized. The power will be generated by a vaporizing of water mechanically, and without the agency of heat. The expense of fuel will thus be saved. Those interested claim to have been misunderstood in saying that a pint of water only would be needed for the propulsion of a train of cars between this city and Philadelphia and back. They meant that if five gallons were used for an engine of 100 horse, a pint only might be lost by vaporization through the pores of the metal. None at all might be lost. *The water, after being vaporized, and passing through the various tubes and chambers, does its allotted work upon the engine, is recondensed into its former state, and, again becoming vaporized, starts again upon its mission of mighty pressure.*"

The foregoing we clip from a recent account of the Keely motor obtained by a *Sun* reporter, at the factory of Messrs. Sergeant and Cullenworth in this city, where a 100 horse power apparatus is alleged to be in process of construction. The italics are ours; and in the sentence thus emphasized, the claims of the deluded believers in the trick are reduced to a point to which, sooner or later, we always considered they must come. It scarcely needs any explanation to prove that the above is simply an assertion of the possibility of the perpetual motion; and that after all, those engineers who have committed themselves to Keelyism stand before the world in the professionally unenviable position of upholding the actuality of that mechanical *ignis fatuus*.

There is no simpler principle in Science than that whatever work is spent in moving a body, through a certain course in one direction, is exactly regained by letting the body return along the same track, friction being avoided. And this is true for every case of natural law. The Keely motor, according to the above, performs two operations, one by which the water is vaporized, the vapor acting on a piston, and the other involving the work which recondenses the vapor. Obviously the work (no matter what its nature may be) required to vaporize the water, acting in one direction, is precisely equal to the work required to condense it, acting in the other direction, other circumstances being equal. Therefore work, drained off to impel other machines, comes from nothing, and the apparatus reduces itself to a self-sustained continuous mechanical motive power. In simpler terms, it is the long-sought problem, exemplified in its simplest form in attempts to lift one's self over a fence by one's boot straps.

Both criticism and speculation regarding the Keely motor must here terminate; for in this enlightened age, no thoughtful person can waste time on that which is so obviously a chimera, unless to contemplate the curious phase in the human mind which sets at naught the dicta of mechanics and mathematics and the admitted laws of Nature. As regards those who have been deceived by the juggle, with its attending fog of unknown forces etc., we can best quote from the preface of Dirck's work on the *Perpetuum Mobile* "The theoretical and practical engineer, unhappily led away by this substitution of prolific fancies in place of sound judgment, is the last person to be convinced by the most obvious obstacles to success in the fulfilment of his views and statements. To himself, all his opinions stand for realizable objects. We cannot avoid having some, though a very chastened, sympathy with such enthusiastic projectors, who would seem to pride themselves on the strongly expressed notion that 'genius to madness is near allied.' It is unquestionably in such cases a constitutional weakness, ill fitting its possessor for that calm, cool, reflective character which alone commands confidence and secures respect."

How to Make Small Racks for Gears.

To cut small racks, to fit pinions made from pinion wire Secure the blanks, on which the teeth are to be cut, in slots cut in a mandrel of large diameter. Put the mandrel in a lathe, and arrange the screw gears to cut a thread of the same pitch as the teeth in the pinion; and with a tool of the proper form, cut the teeth in the blanks. The pitch of the thread will not be appreciable if the racks have a narrow face.

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THE CENTENNIAL EXPOSITION.

We give on the opposite page a fine engraving of a portion of the interior of the Main Building at the Centennial. The artist has also represented the procession which, headed by President Grant and the Emperor of Brazil, passed through the different edifices immediately after the opening ceremonies. The distinguished party was received by the various foreign commissioners, who, with their respective committees, had posted themselves in front of their departments and along the principal aisle. The three gateways, shown in the illustration, belong to Spain, Egypt, and Denmark, and are the most elaborate temporary decorations which have been erected. Egypt surrounds her entire section with a low wall of wood and canvas, painted to imitate stone. There is a noticeable absence of display of this kind in the departments of England and France. England, especially, avoids even ornamented show cases, and presents her exhibits in plain but handsomely made cases, which do not distract the eye from the articles themselves.

THE JUDGES.

The most important event of the past week has been the organization of the board of judges. The formal ceremony took place on May 24, in the Judges' Hall, into which first marched the Centennial Commission, headed by General Hawley, and followed by the American judges. As the foreign judges entered all rose, and patriotic airs were performed by the band. General Hawley then extended a welcome to the foreign members, and Mr. Goshorn delivered a brief speech relative to the duties of the Board.

THE UNITED STATES EXHIBIT—SIGNAL BUREAU.

In our review last week of the general condition of affairs at the Exposition, lack of space compelled us to omit mention of the United States Building, the arrangements in which are nearer completion than in any other part of the Exhibition. On each side of the main portal is arranged a formidable collection of cutlery. There is a mammoth 20-inch Rodman gun, and several Dahlgren smooth bores and Parrott rifles of smaller proportions. These are mounted on their carriages and provided with all fittings and appurtenances. Inside the building one of the most interesting displays is that of the Signal Service Bureau. It is intended to show a signal station with all its appliances. The principal instruments exhibited are as follows: Lieutenant Gibbon's barograph, or self-registering barometer is the usual siphon-shaped mercurial barometer, in the short leg of which an iron float rests upon the column of mercury. The slightest change in the level of the column makes this float rise or fall, and its motion is communicated by a cord running over a pulley to the circuit breaker of an electromagnet. The armature of the magnet communicates its motion to a pen which dots the surface of a cylinder moved slowly by clockwork, thus registering the slightest change and the exact moment of its occurrence. The paper with which the surface of the cylinder is covered is ruled to cover a space of fourteen days; and as each paper is removed, it is filed away as a permanent record of that period of time. Foreman's barograph is in its leading characteristics like the one above described, and has also an attachment which automatically prints in figures each change of one thousandth of an inch.

Hough's thermograph is a self-registering thermometer. It consists of a siphon tube, the short leg of which is expanded into a larger tube with a closed end. In this short leg is placed alcohol, which is confined there by a column of mercury in the longer leg, which is open at the top. The thermometer operates by a contraction and expansion of the spirit by cold or heat, raising the column of mercury as the spirit expands, and letting it sink as it contracts. Upon the surface of the mercury is a float, which rises and falls with the column, and, by a very delicate apparatus, operates a circuit breaker of an electromagnetic circuit. This again, as in the case of the barograph, is made to record the changes of a revolving cylinder.

A marine barograph is constructed much like the one first described, except that the tube containing the mercury is made of iron instead of glass. It has an attachment to hang it up by, which keeps it always in a perpendicular position.

Eccard's evapograph is an instrument for determining the amount of moisture in the atmosphere, and registering the result. This is determined by the rapidity with which water, exposed to the atmosphere, will evaporate. The instrument is an open cylindrical vessel filled with water, resting upon a delicate scale; as the water evaporates, the vessel is lightened and rises, the slightest change being sufficient to operate the circuit breaker of an electromagnet, which, as in other instruments, records the changes on the cylinder moved by clockwork. The motion, of course, is always upward, as evaporation continually goes on with greater or less rapidity.

Gibbon's electrical rain and snow gage records in like manner the depth of the rain or melted snow which falls in any given time. A receiver is situated on the roof of the building, the area of the upper section of which is a certain number of times as great as the base of the cylinder of the instrument, with which it is connected by a tube. Upon the water in the lower cylinder is a float, which, as it rises, communicates its motion by an electromagnet to the recording apparatus as before described.

Eccard's rain gage dispenses with the electro-magnet, the float communicating its motion by a counterpoise to the clockwork. This is a very simple and effective instrument.

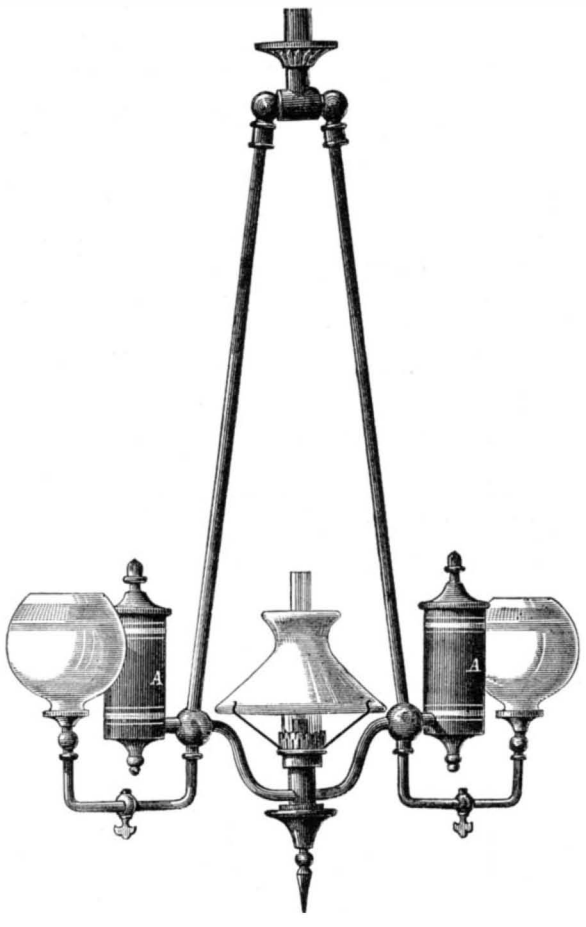
Gibbon's anemograph measures and records the velocity and direction of the wind. Upon the roof of the observing station, four hemispherical cups, placed vertically on horizontal arms, catch the slightest movement of the air and cause the arms to revolve a certain number of revolutions, equaling, in the distance traveled, the distance traveled by the wind; then an electric circuit closes, and an electromagnet records the same on a revolving cylinder. This cylinder, moving by clockwork, should there be no movement of the magnet, will cause the pencil to make a long, straight line; with a high wind the record is frequently made, and the line is broken up into longer or shorter sections, corresponding with the velocity of the wind. The direction is indicated on another cylinder. There are four magnetic circuits, connected with the four points of the weather vane, corresponding with the four points of the compass. Once in four minutes the clockwork makes a record, and that record is made by the pen of whichever circuit the weather vane has at the time closed. Eccard's anemograph dispenses with the electric circuit, and makes its record on the cylinder by entirely mechanical means. The weather vane, in turning, revolves the rod to which it is attached, which communicates its motion directly, or by gearing, to the pen, without the intervention of an electromagnet.

An ingenious apparatus has been constructed to provide the weather necessary to work these different instruments. It includes a shower bath to produce an artificial rainstorm, and a fan blast, which generates gales of any force, from ten to sixty miles per hour. The manner of printing the weather maps, which are sent to all parts of country, is fully illustrated in this department.

CLARK'S COMBINED GAS AND OIL CHANDELIER.

The exorbitant price charged for gas in some large cities has resulted in a greatly increased use of oil, which is much the cheaper mode of illumination Various devices have been introduced to combine oil lamps with gas fixtures, so that the latter, being already in most city houses, may still be utilized and the expense of separate lamp holders saved. To this class belongs the present invention, which ingeniously arranges a lamp in connection with a gas fixture, so that either gas or oil, or both, may be burned, as desired.

The construction consists simply in carrying a separate gas pipe to each arm of the fixture. To each pipe is attached an oil tank, A; and these tanks communicate, by tubes supported in bulbs, to, but do not intersect, the gas pipes, with the argand burner in the middle. The gas is lit at the extremities of the arms; and the light is increased at a small cost by the oil illumination, or the gas may be unused, and only the lamp lit.



One advantage of this arrangement is that it does not compel the cutting-off of the gas, as is the case when a lamp is fitted directly over the burners; so that, while lamplight may be ordinarily employed on special occasions, when greater illumination is desired the gas burners may be ignited. The invention will doubtless be quite popular not only with consumers but also with gas companies, since it tends to prevent the return of meters and total abandonment of the gas facilities, as might otherwise follow a substitution of oil.

Patented May 9, 1876, through the Scientific American Patent Agency. For further particulars regarding sale of patent, rights, etc., address the inventor, Mr. George P. Clark, P. O. Box 327, Newton, Mass.

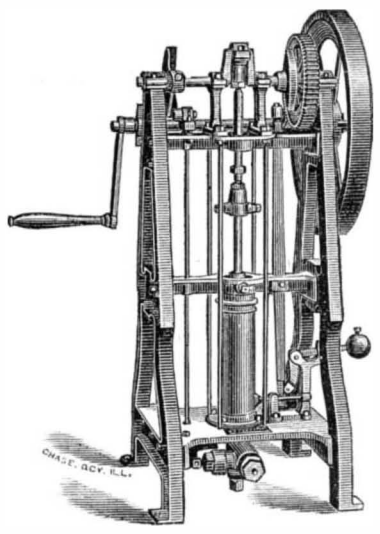
A Metal More Fusible than Tallow.

M. Lecoq de Boisbaudran, whose recent discovery of the new element gallium, and whose subsequent researches thereon we have from time to time noted, has recently, for the first time, succeeded in obtaining a grain and a half of the metal in a pure state. This has enabled him to determine the remarkable fact that gallium melts at 85·1° Fah., so that it liquefies when held in the hand. When solid, the metal is hard and resistant, even to a few degrees below the melting point. It can be cut, and possesses a slight malleability. When fused, it adheres easily to glass, on which it forms a beautiful mirror, whiter than that produced by mercury. It oxidizes but very superficially when heated to red ness in the air, and does not become volatile. The density at 59° Fah. is 4·7, that of water at 39·2° Fah. being 1.

Excepting mercury, which only becomes solid at —37·9° Fah., there is no other element which liquefies at so low a temperature as gallium. Fusible alloy, of 1 part lead, 1 part tin, and 1 part bismuth, melts at 201°, and phosphorus at 111·5°. Wax and tallow have melting points respectively at 142° and 92° Fah.

MOLL & ALTHEIDE'S IMPROVED AIR PUMP.

The accompanying illustration represents an improved air pump, which, the inventors claim, produces an absolute vacuum. The valves are operated by means of cams and levers, insuring a positive motion and a greater efficiency than it is



possible to secure where atmospheric pressure alone is relied on to open and close the valves. We have never seen the apparatus: but it is stated by the inventor that the perfection of this machine is such that it may be used by manufacturers of thermometers, barometers, sympiesometers, Geissler tubes, and other physical apparatus, to advantage. It is also said that manufacturing chemists and sugar refiners can by its use ob- tain superior productions in less time and with less expense than by excessive heat.

The apparatus consists of a cylinder placed on a platform, which is secured to two vertical standards, at the top of which a crank shaft is supported in suitable bearings. A spur wheel is keyed on one end of this shaft, which takes its motion from a pinion on the shaft, which is shown at the back of the ma chine. There is a balance wheel and also a hand crank for operating the machine on this last mentioned shaft. A crosshead on the end of the piston rod is connected to the crank shaft by means of a connecting rod.

A cam is fixed on the end of the crank shaft (at the left hand in the engraving) which operates the induction valve by means of the rod shown near the side of the machine, which carries a roller which engage s with the cam. The lower snd of the rod just mentioned is connected with a lever which operates the induction valve, and is weighted so that, when the cam is not in contact with the roller, at the upper end of the rod, the weight will hold the valve closed.

On the other side of the machine, a cam is attached to the side of the spur wheel, which operates the eduction valve through a lever carrying a roller at its upper end, and having a fulcrum at the cross bar, which connects the vertical standard just above the upper end of the cylinder, and is connected at the lower end with the valve. Near this le ver, a standard is fixed to the platform, which supports a right-angled lever carrying a weight at its outer end, and a flanged roller at its inner and lower end, which bears upon the lower end of the valve-operating lever.

Atmospheric pressure is depended on to operate the valves, as they are opened by the cams, and closed by the weighted levers. By this arrangement, it is claimed that the instant of opening and closing the valves can be regulated to better advantage than when they are arranged to operate automatically. This pump is provided with valves of new and peculiar construction, and also an improved packing for the piston, which add to the efficiency of the machine.

Patented October 19, 1875. For further information, address the inventors, C. F. Moll and J. H. Altheide, Quincy, Ill.

Production of Silver in the Whole World.

According to recent statistics, the production of silver in the whole world in 1800 was $35,000,000, which rose in 1850 to $42,500,000, in 1854 to $47,500,000, and in 1865 to about $62,500,000. The production of this precious metal during the year 1873 is subdivided as follows: England and its colonies, $10,000,000; Norway, Sweden, and Denmark, $250,000; Russia, $500,000; Austria, $1,620,000; Germany, $3,000,000; France, $2,000,000; Spain, $2,000,000; Sardinia, $500,000; Mexico, $20,000,000; Central and South America, $8,000,000; Canada, $900,000; the United States, $36,500,000, which gives a total of $85,250,000. Including the year 1873, it is estimated that the total production of silver, since the discovery of the New World by Christopher Columbus, has been $715,000,000, the largest source of accession, during late years, being due to the Nevada mines.

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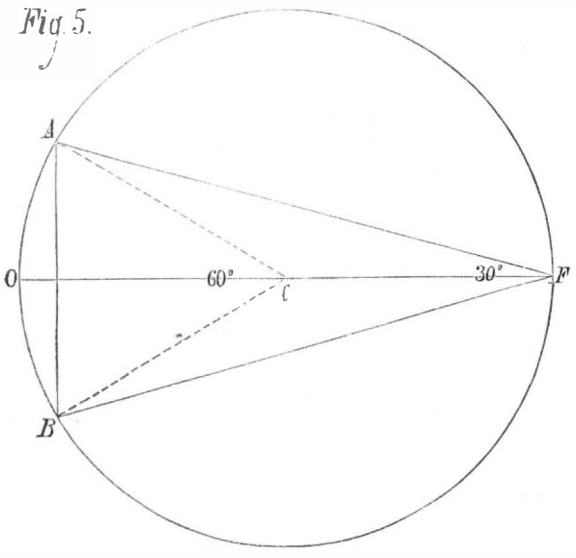
(*Continued from first page.*)

to minute experiment by Professor Tyndall. That scientist finds the device to be of greater efficiency, while its cost is about one quarter of that of the Fresnel apparatus of similar power, with which it was compared. The Italian government has also conducted comparative experiments between the Balestrieri and lenticular systems, in a lighthouse at Civita Vecchia, and the official commission report the exceeding superiority of the new apparatus.

It being proposed to adapt the invention to the lighting of cities, experiments were lately tried in Rome. The light was placed on the Piazza del Popolo, so as to illuminate the Corso. An oil lamp of considerably inferior power to that used in a lighthouse of the second order was caused to throw a light by which a letter, written in fine characters, could be read at a distance of about 2,000 feet. The inventor has recently devised a smaller apparatus which, at a distance of 224 feet, projects a beam 80 feet in diameter, the source of light being a single butterfly gas burner. This is especially adapted to the lighting of our streets and buildings with great economy of gas.

Fig. 5.



Another important application of this invention is the accumulation not merely of light but of heat rays. A lens 3·2 feet in diameter has an area of 1178·1 inches, and supposing this to reduce the sun's image to 0·15 inch, then the emergent light is condensed 7,854 times. Now, under the most favorable circumstances, a Fresnel lens does not transmit more than one fourth the heat it receives; hence the sun's heat is condensed but 5,236 times. It is possible, says *Les Mondes*, to make a Balestrieri apparatus of two, three, four, or five times the size of the lens; and the calorific effects, increasing directly as the squares of the diameters, will be four, nine, sixteen, or twenty-five times as great as those of a lens of the above-stated size. It seems possible, therefore, to obtain a calorific intensity capable of reducing even the most refractory substances.

[This is a notable example of the way in which American inventions are "re-invented" and the credit monopolized by Europeans. Substantially the same device was patented in this country, as a locomotive headlight, on July 18, 1871, by C. S. Lee and W. M. Baldwin, of Troy, N. Y., and was described in the SCIENTIFIC AMERICAN at that time.—EDS.]

The Newly Discovered Mechanical Action of Violet Light.

M. Paul Bert's recent investigations as to the cause of changes of color in the chameleon have led him to a discovery of considerable importance, since it indicates a mechanical effect of light, and more especially of the violet rays, hitherto entirely unknown. He traces the changes of hue of the reptile to minute corpuscles or chromoblasts, which are located either below the dermis or at the surface of the skin, according as they are affected by certain nerves which are respectively analogous to the vaso constrictors and vaso dilatators. When the chameleon is placed half in red light and half in violet light, obtained by passing sunlight through colored glass, the portion on which the red light falls remains of the normal yellow color, while that affected by the violet light changes to a greenish black hue. This same effect can be produced by suitable nerve excitations and divisions, showing that the accession of color on the skin is absolutely caused by the rising of the colored corpuscles to the surface; while, when the latter remain inert, the natural yellow hue of the creature continues unchanged. Hence it would appear that the colored corpuscles, like certain chemical substances, are not equally affected by all the rays of the spectrum, and that in the violet blue rays alone resides the property of mechanically moving the chromoblasts and drawing them to the surface.

Similar action on contractile substances has already been noted as caused by heat and electricity; but that light should possess an exciting effect of this description is certainly remarkable.

M. Bert proposes to continue his researches to determine the influence of light on contractile matters under other circumstances, and he especially hopes to discover the reason of the favorable influence of light on the skin of children and of lymphatic persons. It seems to us he might go further and observe whether the color in the human skin, either that normally existing, as in the case of negroes, or that obtained by direct exposure to sunlight (tanning or burning), is attributable to any similar cause

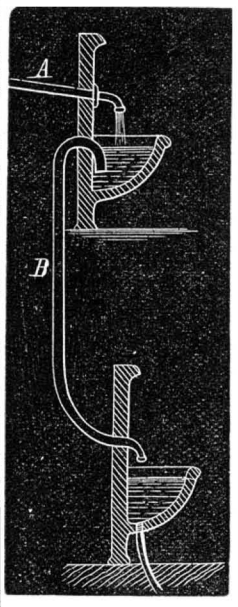
There is one fact worthy of remark here about M. Bert's discovery, and that is that it happens at a singularly opportune time, to be taken advantage of by those who are inclined to consider seriously the supposed influence of sunlight filtered through various colored glasses on phenomena of growth and of disease. Dr. Ponza, an Italian physician, has recently stated that light of certain colors has a beneficial effect on lunatics and other persons suffering under nervous ailments; and since M. Bert has demonstrated in the chameleons the direct influence of light on a nervous system, it appears not improbable that Dr. Ponza's alleged results may have some foundation.

Correspondence.

Intermittent Springs.

To the Editor of the Scientific American:

J. S. O.'s assumption, on page 283, vol. 34, though theoretically plausible, will not upset the accepted theory of intermittent springs, as the following facts will show; Some years ago, while residing in a small village where a club pleasure ground was kept, I was requested to engineer a couple of drinking fountains, one situated on a hillside and the other about 20 feet below, on the main walk. I led the water by a gentle descent from the springs by the pipe, A, to the upper basin, from which the overflow was to be carried through the larger pipe, B, to the lower fountain. Business called me away at the time the pipe connections were being made; the plumber made a change in my plan, producing a comical effect. All were laughing at my fountain when I returned, and one old gentleman described his experience thus: "I was walking on the lower walk, and saw a large stream flow from the fountain; I walked up and took the cup for a drink, when it suddenly stopped. My wife came up, and we were both much surprised. I thought something had got in the pipe, and stooped down to look, when I heard a gurgling sound; and my wife and I were splashed all over with water. You have played us a fine trick." I at once suspected what was the matter, and found in fact that, instead of a perforated plate being placed at the outflow of the upper fountain, the plumber had bent it into a siphon, thinking to prevent the entrance of rubbish. I had a small hole perforated at the top, and the intermittent spring ceased. The theory is that the water, falling from the crown of the siphon, when the pitch is vertical or great, rapidly carries with it the small amount of air in the bend, the place of which is at once occupied by water.



GEORGE H. HENSHAW.

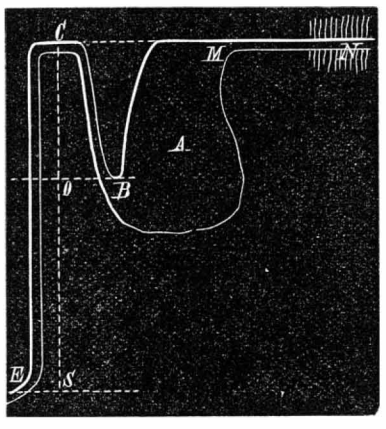
Ste. Anne Bout de l'Isle, Canada.

Intermittent Springs.

To the Editor of the Scientific American:

In your issue of April 29, J. S. O. says: "The generally accepted theory of intermittent springs is that a cavity in the earth has two water channels, one leading into it, the other out, the former being the smaller." Is this the theory? I have examined at different times a number of the standard works on this subject, and I do not think that we must take into consideration so much the size of the tubes as the amount of water which flows through them. More water will flow through a long tube held vertically than through a shorter one of the same bore.

In the engraving, A is the cavity, M N a horizontal tube conducting the water into the cavity, and B C E the siphon



tube of the same size as M N, tube through which the water flows out. If only enough water is collected, in the tube M N, to keep it constantly full, the velocity of the water, as it flows through the tube, may be expressed thus: $v = \sqrt{g\,d}$ (g representing the force of gravity, and d the diameter of the tube). As the water flows into and fills the cavity, it also fills the shorter arm of the siphon; and because it is just as large as M N, the water will rise to the top of the siphon at C. As the siphon is now charged, the water will flow down the longer arm, increasing in velocity at every instant, according to the laws of falling bodies, until it reaches the end at E, when it will flow through the whole siphon with a velocity equal to $\sqrt{2\,g\,h}$ (h being equal to the hight of the water in the cavity above the spring, at E). Now as $2\,h$, in the formula, may be very much greater than d, so may the velocity be much greater in flowing out than in flowing in; hence, the cavity will be emptied and the water will stop flowing out until it is again filled, and so on. When the water first begins to flow out, h is equal to C S, but when it has fallen in A to B, h has decreased to O S; so, as the water falls in the cavity, the velocity of the flow constantly decreases. If the diameters of the tubes be 1 inch, and C S be 20 feet, the velocity of the flow into A will be about 1·6 feet in a second of time; and that of the flow out, at first, about 35·8 feet.

In all intermittent springs, the velocity of the flow, as it continues, must decrease; and as the cavity is shallow or deep, this decrease is small or great.

Canonsburgh, Pa. JAMES F. RAY.

ASTRONOMICAL NOTES.

OBSERVATORY OF VASSAR COLLEGE.

The computations and some of the observations in the following notes are from students in the astronomical department. The times of risings and settings of planets are approximate, but sufficiently accurate to enable an ordinary observer to find the object mentioned. M. M.

Position of Planets for June, 1876.

Mercury.

On June 1, Mercury rises at 5h. 44m. A. M., and sets at 8h 44m. P. M. On the 30th, Mercury rises at 3h. 36m. A. M., and sets at 5h. 58m. P. M.

Mercury was at its greatest elongation on May 21, but can be seen after sunset for some days later, probably through the first week of June, as it sets at a point north of that at which the sun is last seen.

Venus.

Venus must be known to all who at this time observe the western sky. It does not attain the greatest brilliancy until June 7.

Venus rises on the 1st at 7h. 26m. A. M., and sets at 10h. 33m. P. M. On the 30th, Venus rises at 6h. 18m. A. M., and sets at 8h. 36m. P. M.

Mars.

Mars is very small. It can be found by its nearness to Venus, setting an hour later than Venus, on June 1, and at almost the same time on June 30.

Jupiter.

Jupiter is now well above the horizon in the evening, and can be seen as soon as twilight is over. It rises on the 1st at 5h. 56m. P. M., and sets at 3h. 42m. of the next morning. On the 30th, Jupiter rises at 3h. 49m. P. M., and sets at 1h 39m. the next morning.

The satellites of Jupiter revolve around the planet in such short periods that their changes of position can be seen in a watch of a few hours, and on almost any evening one may pass across the disk of Jupiter, making what is called a transit; or it may be hidden by passing into the shadow of Jupiter, in eclipse; or Jupiter may come between us and one of its moons, as in occultations.

These phenomena can be very nicely seen on June 15. According to the *Nautical Almanac*, on this evening the shadow of the first satellite passes across the disk of Jupiter; this cannot be seen without the use of a good telescope. At 9h. 26m. (Washington time) the third satellite, which is the largest, reappears, having been behind the planet for several hours; at 9h. 52m. the first satellite leaves the disk, having been in passage across it for more than two hours, and at 12h. 6m. the third satellite disappears by going into the shadow of Jupiter. On this evening only two of the satellites will be seen from 8 to 9.30 P. M.

Saturn.

Saturn is coming into better position. It rises on the 1st at 0h. 36m. A. M., but on the 30th comes above the horizon at 10h. 39m. P. M., and sets at 9h. 25m. the next morning.

Saturn is among the small stars of *Aquarius*, about 2° south of the star λ.

Uranus.

Uranus is among the stars of *Leo*. It rises, on the 1st, at 9h. 30m. A. M., and sets at 11h. 35m. P. M. On June 30, Uranus rises at 7h. 45m. A. M., and sets at 9h. 45m. P. M.

Neptune.

Neptune cannot be seen without a good glass, and at present is very unfavorably situated, as it comes to the meridian in the daytime.

Sun Spots.

The report is from April 20 to May 21, inclusive. During the past month, the surface of the sun has been remarkably free from spots. The present seems to be the minimum of the sun spot period. On May 6 a small spot appeared coming on. The observation of May 11 showed that this had divided into an elongated pair, which was followed by two very small ones. On May 11 these had disappeared, and the elongated pair had united into one, which was not seen after May 13. From that date till May 21 no spots have been found.

Dyeing Cotton Blue.

For 5 lbs. goods, dissolve 1 oz. copperas in 4 gallons of soft water. Wet the goods in warm suds, put them in the copperas water, let them remain 10 minutes. Dissolve in another vessel 2 ozs. prussiate potash in 4 gallons soft water. Wring your goods, put into this solution, let them remain 5 minutes; wring out again, now add 1 oz. oil of vitriol to the potash water, and stir well; put the goods in again and bring to a boiling point, letting them remain until you obtain the desired shade.

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[For the Scientific American.]

THE SCERTAIN THE PROPER LENGTH OF A CONNECTING ROD.

It is not often that the owner of a steam engine possesses any detail drawings of it; and hence when it requires renewal in its various parts, taking up the wear and lost motion, with a view to keep the parts in line and as nearly as possible of the original dimensions, is left largely to the judgment of the repairing engineer. In the case of connecting rods, however, this is at times neither practicable nor desirable, for the reason that the bearings of main shafts are apt to vary in their distance from the cylinder, by reason of the wear in the bearings or brasses, which wear tends in engines in which the crank shaft is above the cylinder, to shorten the distance between the two, the reverse being the case when the cylinder is above the crank. In horizontal engines, this is not so appreciably felt, for the reason that the wear is not so much in the direction of the length of the piston rod. When the main bearing brasses, of either vertical or horizontal engines, have been much worn, and have had the lost motion taken up at various times, they will be found, in most instances, to have varied in their distances from the steam cylinder, which may be compensated for when taking up the lost motion of the connecting rod, by making the length, from center to center of the brasses, equal to the distance from the center of the main shaft to the center of the guide bars.

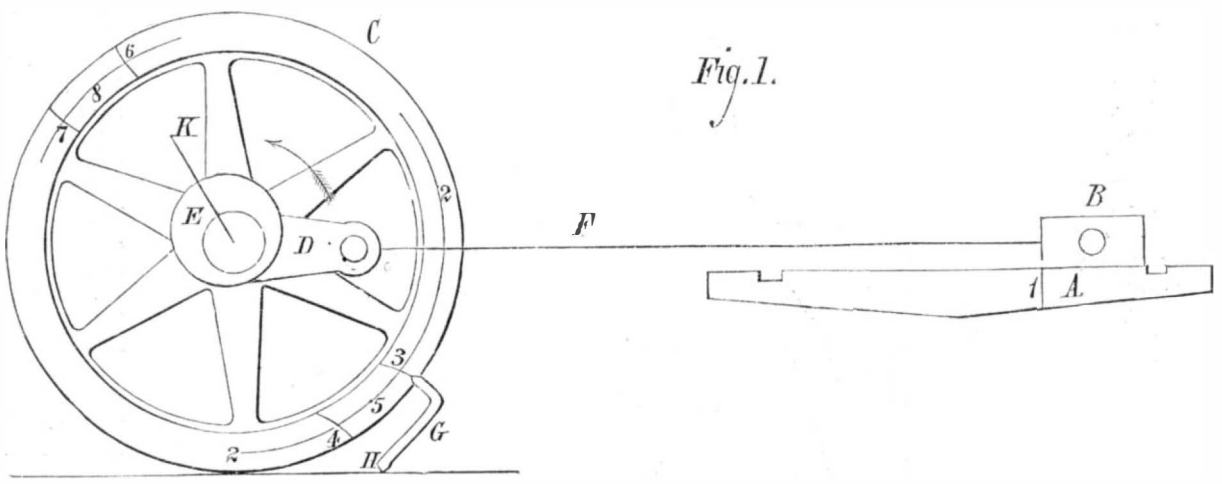


Fig. 1.

In renewing the main shaft bearings or the connecting rod, however, it is better to ensure that, the bore of the main shaft being in the center of the brasses, the length of the connecting rod is made such as to leave the clearance, between the piston head and the cylinder covers at the ends of the stroke, equal, and not to take it for granted that such is the case when we measure from the center of the guide bars or crosshead journal to the center of the main shaft. It will not do to measure from the center of the crosshead journal to the center of the crank pin when the latter is at midstroke, because, when the crank pin is in that position, the crosshead does not stand in the center of its travel on the guide bars, because of the angle at which the connecting rod

Fig. 2.

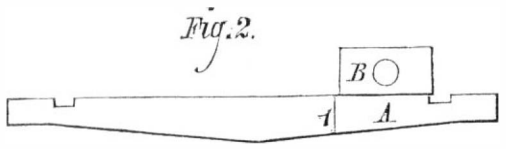
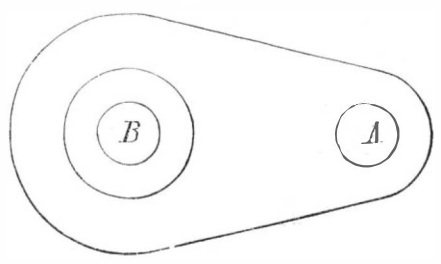
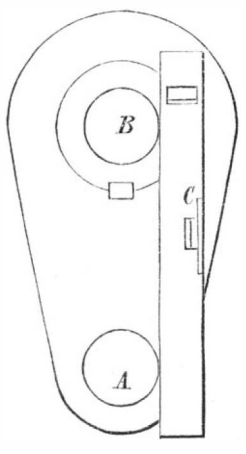


Fig. 3.



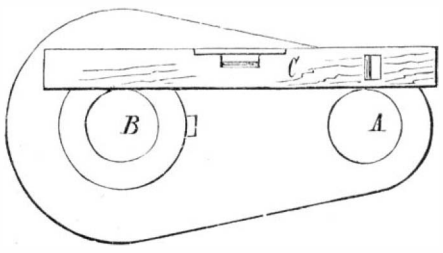
stands. The piston head will, in all cases when the crank stands at the center of its stroke travel, stand nearer to the cylinder head which is nearer to the crank than it does to the opposite cylinder head, the amount of the difference being dependent upon the length of the connecting rod as compared to the length of the engine stroke. If the connecting rod be shorter than the stroke, the greater is the difference referred to. From these considerations, it becomes necessary to make the connecting rod of a length to ensure that the clearance shall be equal at the ends of the piston stroke, which should be done as follows:

Fig. 4 I.



Place the piston at one end of its stroke by the following process: In Fig. 1, A represents the guidebar, B the guide block, C the fly wheel, D the crank, E the eccentric, and F the center line of the connecting rod of an engine intended to run in the direction of the arrow Giving the wheel a turn or two in the direction in which it is intended to run, we allow it to come to rest so that the motion block, B, will be at very nearly the end of its stroke on the guide bar, A, and then placing the edge of a straight edge along the end of the guide block, B, the straight edge at the same time overlapping the face of the guide bar, we mark on the face of the latter the line, 1, which will then be quite even with the end face of the guide block. We then (after chalking it to make the marks show plainly) mark on the face of the wheel the line, 2, which should be true with the center of the main shaft, but which can be marked from the rim of the wheel with a pair of compass callipers, provided that rim has been trued up in the lathe. We next, with a piece of iron wire or rod, bent as shown by G, make, at some fixed point, such as shown at H, a centerpunch mark; and resting one end of the scriber, G, in the fixed centerpunch mark, we scribe with the other end upon the edge of the wheel the line, 3, as shown in the illustration. Our next operation is to move the wheel forward in the direction in which it is to run, so that the crank will move to the dead center, and the guide block will leave the line, 1, as shown in Fig. 2; and the motion of the wheel being continued, the guide block will return to the mark, 1, the wheel being moved very slowly indeed, so that there will be no trouble to so move it that the end of the guide block will come to rest exactly fair with line, 1. We then take our wire scriber, rest one end in the fixed point, and with the other edge mark, on the edge face of the wheel, line 4, which will then occupy the place that line, 3, does in our engraving. Our next duty is to find the center between the lines 3 and 4, which we mark with a fine centerpunch mark, as shown at 5. And it will be readily be perceived that, if we move the wheel round so that the scriber, G, rests in the fixed center point, as shown in Fig. 4, at A, the other will be true with the centerpunch mark, 5, and the motion block; and hence the piston and crank will be exactly on the dead center at that end of the stroke.

Fig. 4 II

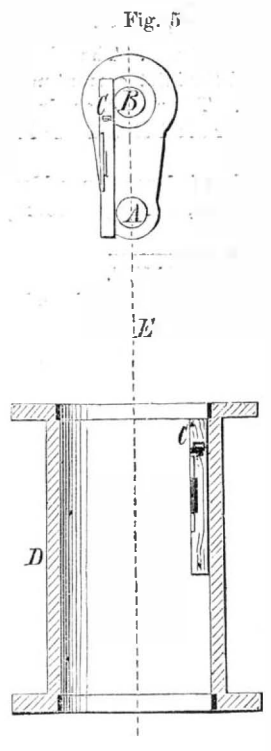


Then place the crank on its dead center, by the process here given. On the end face of the crank, and from the center of the shaft, strike a circle equal in diameter to the crank pin, as shown in Fig. 3, A representing the crank pin journal and B the circle referred to. Then take a spirit level, and place one end of it on the crank pin journal and the other end even with the circle, above referred to, as shown in Fig. 4, A representing the crank pin journal, B the circle, and C the spirit level in each case, position I being for a vertical and position II for a horizontal engine; and presuming the engine to be leveled true, the crank will be on its dead center when the bubble of the spirit level stands true; if, however, the bore of the cylinder is not quite level, place the spirit level in the cylinder bore and properly adjust it parallel with the bore of the cylinder, and then mark on the face of the spirit level a line exactly even with the center of the bubble, or else two lines just even with the two ends of the bubble; and set the crank so that, when the spirit level is applied to the crank pin and the circle, the bubble will stand in the same position as it did when in the bore of the cylinder, and the crank will stand on its dead center. It must, however, be remembered that, in the case of the vertical cylinder, the spirit level must be applied in the cylinder as shown in Fig. 5, in which A represents the crank pin, B the circle, C in each case the spirit level, D the engine cylinder, and E the center line of the cylinder, it being obvious that it would be useless to apply the spirit level in any position, relative to the crank, in the cylinder. The crank and piston being thus placed in position at corresponding ends of the stroke, the length of the connecting rod is the distance from the center of the crosshead journal to the center of the crank pin.

JOSHUA ROSE.

New York city.

Fig. 5



No More Wooden Nutmegs.

At a reception recently given by the Turners' Company of London to Lieutenant Cameron, R. N., as a recognition of his services in exploring the African continent, the guest of the evening, alluding to what he saw in his travels, said: "The country of Nyangwe, I firmly believe—in fact, I am sure—may be reached by the Congo; and hereafter I hope that where my steps have been we shall see a system of English trading stations for the purchase not only of ivory, for the richness of the vegetable products of the country is something beyond description. I have walked along for fifty or sixty yards under a grove of nutmeg trees, with the whole ground covered with nutmegs, and no one knew what they were worth. Besides that, there are many other vegetable products in abundance, many different species of cotton, and oil-producing palms. Up the valley of the Congo, to a hight of 2,600 feet above the level of the sea, the country is crowded with oil palm; and hereafter that trade alone, leaving the question of ivory altogether on one side, will be sufficient to well repay any enterprising merchants of England who embark in it."

"What do our readers," says the *London Grocer*, "think of this? We join with them in hoping that Lieutenant Cameron's discovery will turn out to be quite true. It would be cruel for him to deceive us on so vital a point, as cheap nutmegs—such as the public understand by cheapness—have been looked for in vain ever since they were first imported; and we are convinced that in this, as in numberless other cases, it is the supply alone that creates the demand. Give us cheap, sound nutmegs, and the consumption of them will rapidly increase, and limed, worm-eaten, or wooden nutmegs of Yankee celebrity, will gradually become as rare as they are now comparatively common. It is, therefore, to be hoped that the hint thrown out by Lieutenant Cameron with reference to the enterprising merchants of England will be adopted, and that new and profitable channels of trade will be speedily opened up with that secluded corner of the globe."

A Remarkable Surgical Operation.

About two years ago, a waiter in a Parisian restaurant undertook to imitate the feats of the Chinese sword swallowers, by introducing a fork, handle foremost, into his throat, taking care to hold the tines in his teeth The attempt was successful, and a repetition was demanded by the loungers in the saloon. The man complied; but while the fork was in his œsophagus, one of his comrades made an ill timed joke, the performer grinned, let go the fork with his teeth, and down it went. The pain was intense. A physician was summoned, who managed to seize the fork with a forceps; but just as he was drawing it up, the patient was seized with convulsive coughing, the doctor was compelled to relax his hold, and the fork slipped down all the way to the stomach. The symptoms of asphyxia at once disappeared, and the man suffered no inconvenience for about two weeks. At the end of that time, however, severe gastric affections manifested themselves, and the patient was sent to a hospital, where he has since, until last month, remained suffering great agony.

In the month of October last, it was decided by the hospital physicians to practise the extraordinary operation of gastrotomy, that is, to cut directly into the stomach and extract the obstacle. It was at first attempted to determine adherences of the viscera from out, inwards, by means of caustics: but this not succeeding, a triangular zone, wherein no essential organs were included, was selected as the point of perforation. In April, the incision was made, the layers of tissue being dissected away one after another. The envelope of the stomach was attained, cut, and a piece removed. The stomach itself was then opened, and pincers introduced; and after a few attempts, the fork was grasped and withdrawn. The wound was closed, and is now nearly healed, the patient suffering only from a slight stomachic fistula, already in process of obliteration. The fork was perfectly black, but otherwise unchanged.

Turbines.

In 1854, Emile Geyelin made a wheel at Saltillo, Mexico, which was a double turbine (that is, a turbine receiving water between two movable wheels on the same shaft, which counterbalanced each other, and avoided the necessity of resisting the thrust from the head of water), for 160 feet fall, producing 125 horse power, and turning at a speed of 1,850 revolutions per hour. This double turbine, though only 11 inches in diameter, propels a cotton mill of 10,000 spindles.

RESTORATION OF FADED WRITING.—Moisten the paper a little with water, and brush over it a solution of sulph-hydric ammonia. Since most inks contain iron, it is easy to understand that there will be formed sulphide of iron, which is black.

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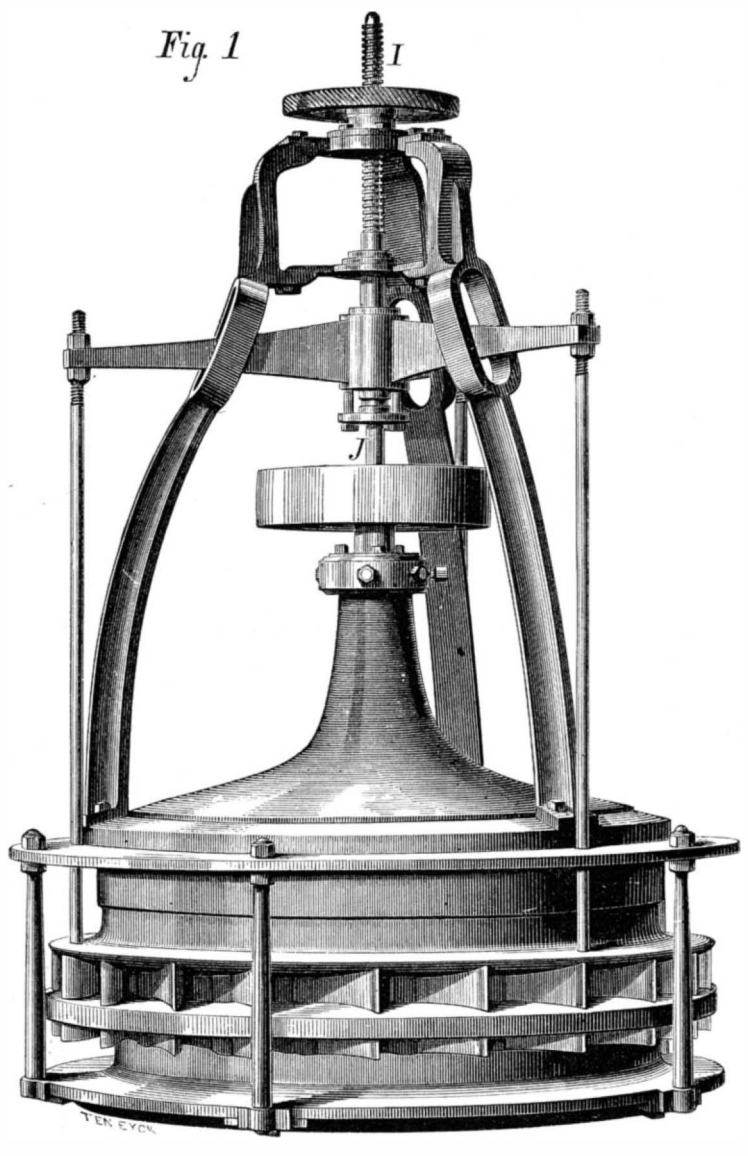
IMPROVED TURBINE WHEEL.

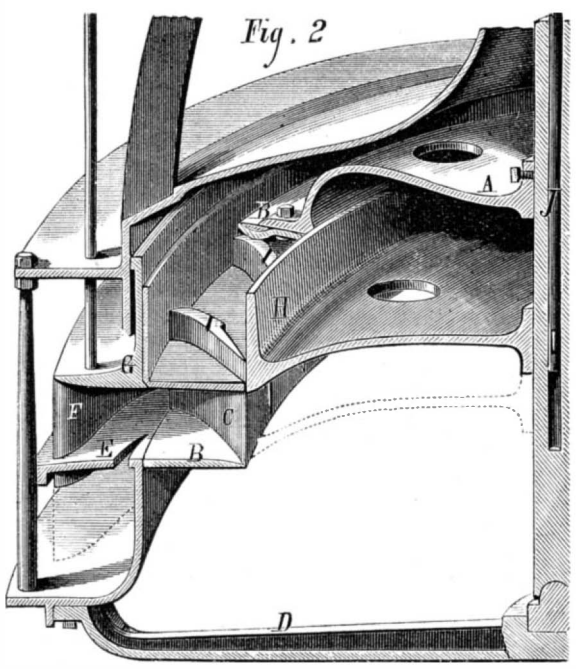
The object of the invention herewith illustrated is to overcome the well known defect of the turbine, namely, a diminished percentage of power when less than full gate is used. To this end, the wheel is made adjustable, and may, without variation of its assigned proportions, by a combined inner and outer gate, have its capacity altered in accordance with the changes of the gates and chutes, and with regard to the power required or modifications in the head. This is claimed to be accomplished without loss in coefficient of useful effect. Fig. 1 represents the wheel complete, and Fig. 2 is a section, showing the inner gate broken away and partly open.

To the crown plate, A, which is cast on the hub, are bolted the annular plates, B, to the lower of which are attached a series of partitions, C, Fig. 2, which form the curved channels or bucket spaces. The casing consists of a dome, as shown in Fig. 1, supported on a curb whose bottom flange rests on the foundation and supports the spider, D, Fig. 2. An adjustable step rests on the center of the spider and forms the lower bearing of the main shaft. The upper flange, E, of the curb is indented, and, inclining downward outwardly, forms the bottom of the chutes. From the edge to the vertical part of the curb extend a series of slots, corresponding in shape to the chute guides, F, and through which the said guides move freely in a vertical direction (dotted lines) when the gates are elevated or depressed. The dome is secured to the curb by pillars, and its bottom edge is beveled inward to repel any obstacles that may collect on the upper side of the gate rim. The outer gate consists of a vertical ring, with a small flange at the top and an indented rim, G, below, having a narrow flange projecting slightly inward under the inner gate. This flange and the edge of the curb beneath it form the shutting surfaces of the outer gate. The width of the small upper flange is proportioned so that the pressure of water under it may counterbalance the weight of the gate and its appendages. It slides on the inner surface of the dome and is packed watertight. The rim forms the upper surface at the mouth of each chute, and it curves downwards so as to direct the water into the chutes and permit sediment to be carried off.

The inner gate, H, is connected by a perforated plate to the hub. Its bottom is made with slots corresponding to the partitions, C, not fitting watertight, however, but having clearance enough to admit water above the plate.

At I is a screw rod, supported in a frame as shown, and operated by the hand wheel. This fits into a corresponding female screw in the hub, and is attached to a spider from which depend rods, secured to the flange of the outer gate. To the hub of the spider, by a ball and socket connection, is attached a rod, J, which passes within the tubular shaft, and is secured to the hub to which is attached the plate of the inner gate, I. The rotation of the hand wheel thus elevates or depresses both gates simultaneously; and the ball and socket connection permits the inner gate to rotate with the water wheel, while the movement of the outer gate is only vertical.





The impact side of each partition, C, is curved inward to a distance somewhat greater than the width of the chutes, and extends thence so as to form a smooth, continuous surface throughout its whole length. The convex side forms a thin edge with the concave side, and curves inward on a different center from the latter. A recess or offset is then produced, and the remainder of the partition is a thin-edged plate. The recess prevents the discharging current from coming in contact with the curved side of the partition after passing the annular point, so that the issuing liquid vein passes clear of the wall of the succeeding bucket, and does not retard the wheel by friction against it. In order to facilitate the discharge, the lower plate, B, which forms the bottom of the buckets, inclines downward at its inner edge. This form of bucket is applicable to both inward and outward discharge wheels. The guides, F, are arranged around the wheel, so as to throw the water to the center. Through these guides and the other surfaces bounding the chutes, the elevation or depression of the outer gate increases or diminishes, not merely the gate area at the opening and shutting edges, but the entire capacity of the chutes.

WALTON'S TURBINE WATER WHEEL.

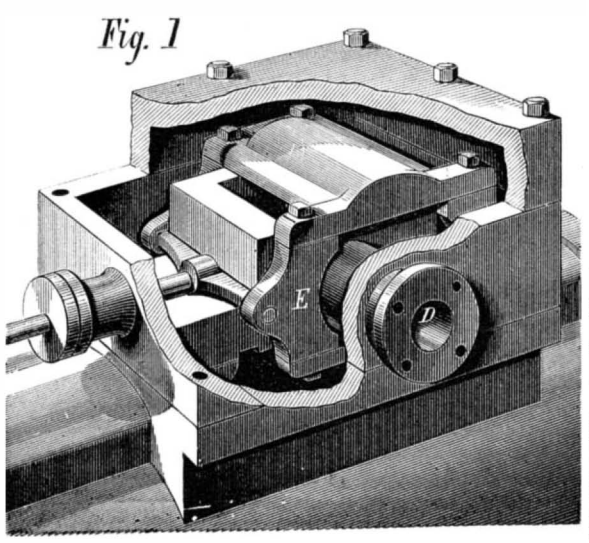
The shallow grooves, shown cut in the tops of the partitions, C, permit water to pass from one bucket into another over the diaphragm, to balance the pressure from below, and keep it equipoised at any elevation in the bucket. The bolt heads, by which the upper plate, B, is fastened to the crown plate, form stops, which prevent the diaphragm from coming into contact with said plate, and preserve more or less space and water passage at all times in the upper part of the bucket.

It will be observed that this arrangement constitutes a device which operates both outer and inner gates, which enlarge and diminish alike the chute and bucket spaces simultaneously, while the wheel is in motion or at rest. The wheel is thus kept properly proportioned and the inlet current maintained constantly at the same angle. The result, as already stated, is the full percentage of power at all elevations of the gate.

Patented July 14, 1874. For further information, address the inventor, Silas Walton, Moorestown, Burlington county, N. J.

IMPROVED BALANCED SLIDE VALVE.

We illustrate herewith an improved balanced slide valve,

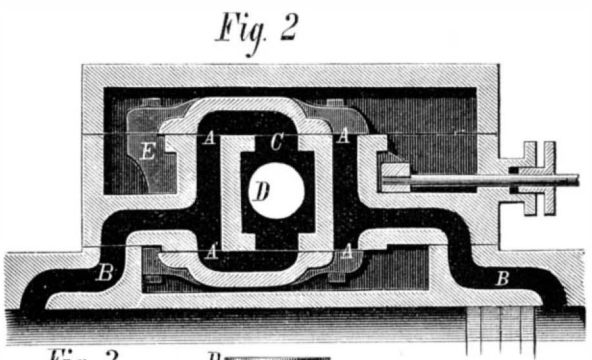


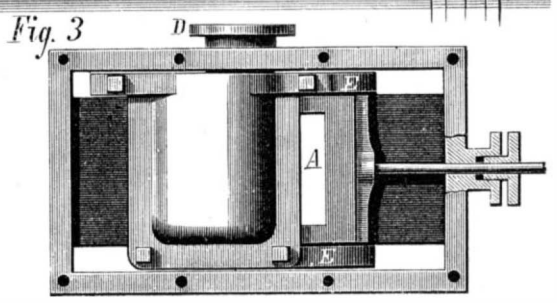
formed of two valves working on opposite sides of the steam ports. These are held in place by bolts and springs, and are balanced through the equal pressure of steam on all sides. The principal advantages claimed are that there is very slight pressure of the valves on their seats, and that, through there being double steam and exhaust ports, the steam acts more rapidly on the piston, and is exhausted more rapidly, with less back pressure.

A perspective view, with the chest broken away to show the valve, is given in Fig. 1. Fig 2 is a vertical section and Fig. 3 a plan view, the cover being removed. The steam ports, A, lead into the passages, B, Fig. 2, at each end of the cylinder. Each passage, therefore, has a double port. The exhaust ports, C, lead into a common exhaust, D. The two slide valves are constructed in the usual manner and are connected by bolts, as exhibited in Fig. 1, said bolts passing through projections on the valves and supports, E. Upon each bolt is a spring to permit the valves to open and discharge condensed water from the cylinder, thus preventing the bursting of the latter. As shown in Fig. 2, steam is entering on the right hand side.

The valve obviously is little subject to wear. It is especially adapted for engines he motion of which it is desirable frequently to reverse, as locomotives and hoisters, since the engineer is afforded control of the machine without requiring steam to be shut off. The valves and ports, being parts of the steam chest, are easily detached, and thus may be readily and economically repaired.

Patented April 7, 1874. For further information relative to sale of rights, territory, etc., address Messrs. Wisner & Strong Pittston, Pa.





Sinking of an Hotel into the Earth.

The St. Louis *Journal* relates the following occurrence, that happened in that city on May 12: "Considerable excitement was created in East St Louis, yesterday morning, on the discovery that Belleville House, a two-story frame building, just south of the Pittsburgh Railroad and Coal Company's dike, near the southern limits of the city, had disappeared in the quicksand. The circumstances connected with the unusual occurrence are as follows: The house, which is used as a hotel, was built on piles, and but a few days before showed evidences of an inclination to sink into the earth. On Thursday night it sunk about two feet; but the proprietor, Mr. F. Decker, not apprehending anything serious, paid very little attention to the matter. On Friday night, the guests went to bed as usual; but at a late hour the clerk, Mr. George Huebner, discovered that the premises were getting rather unsettled, and gave the alarm. Before the inmates could realize what was going on, the building had sunk forty-eight feet, carrying with it ten persons. After considerable difficulty they were all rescued, badly frightened but not hurt. The back water from the river soon surrounded the place where the house stood, and would very probably have carried it away if the gable end, all that is visible, had not been securely fastened to *terra firma*. Mr. Decker's loss on the building is about $6,000, and on furniture about $1,000. The house was recently purchased by the present proprietor; and in all probability it entirely disappeared last night, as very little of it was visible at a late hour."

Powder for Producing Ozone.

In order to produce artificial ozone, Mr. Lender makes use of equal parts of peroxide of manganese, permanganate of potash, and oxalic acid. When this mixture is placed in contact with water, ozone is quickly generated. For a room of medium size two spoonfuls of this powder, placed on a dish and occasionally diluted with water, would be sufficient. The ozone developes itself; it disinfects the surrounding air without producing cough

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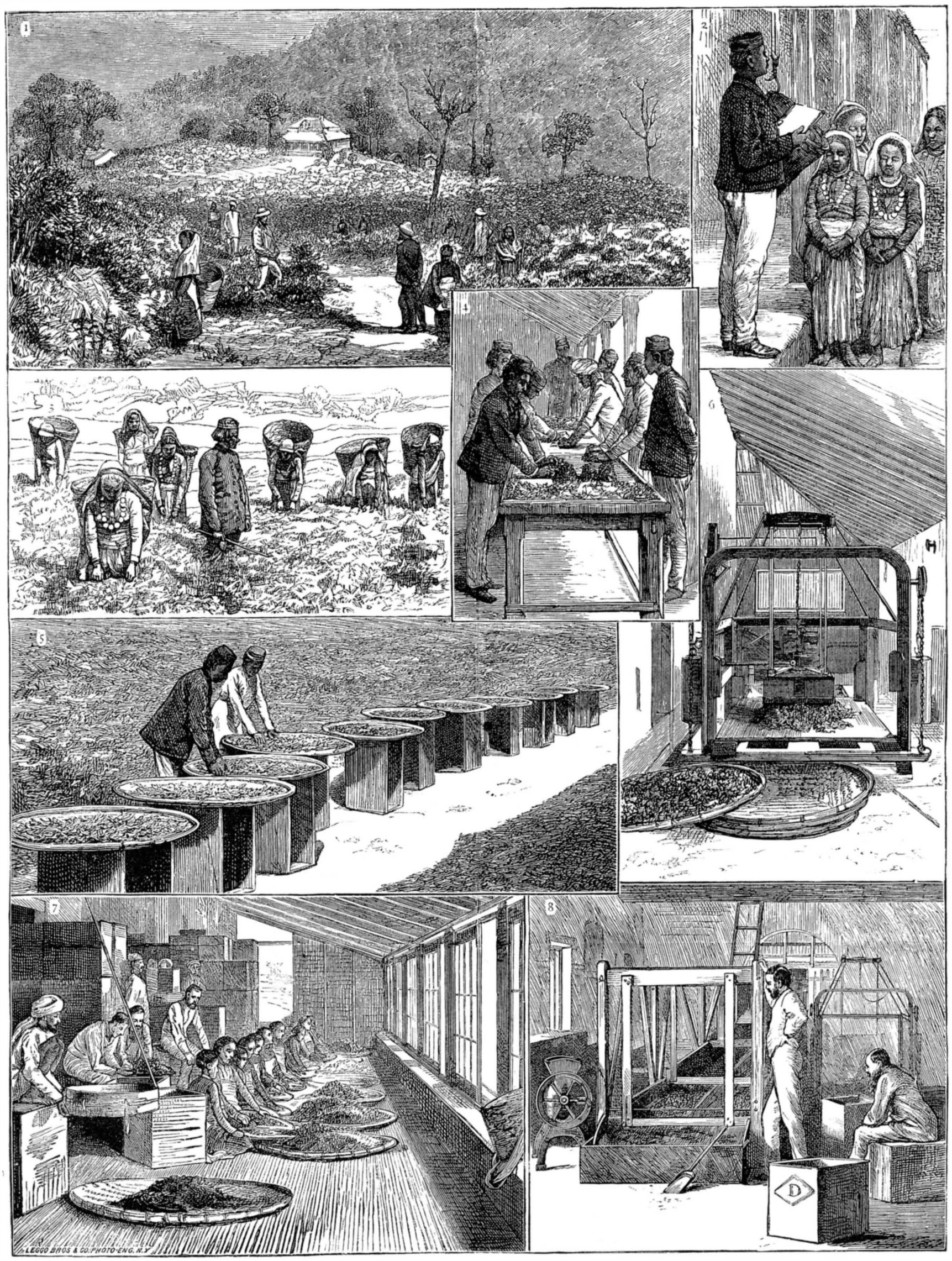
TEA AND TEA CULTURE.

Some time in the third century, says tradition, there lived in China a hermit of great piety. His vigils were long, his prayers constant; but despite a stomach normally empty from fasting, he was ordinarily sleepy. (This part of the story fails to agree with Mr. Buckland's recent assertion that hunger is a prime cause of insomnolence, but the discrepancy is immaterial.) The constant disposition of our hermit's eyelids to close begat in him a holy wrath against the weakness of the flesh; and with sublime indifference to physical pain, the veracious chronicler (scorning physiological probability) asserts, thereupon he cut off the offending eyelids and hurled them to the ground. To a convenient god, who lived near by, this little act of self-abnegation was especially gratifying, and accordingly the eyelids were caused to sprout and grow, generating, not an eyelid plant but the tea plant, in the leaves of which may yet be traced the lids and eyelashes of the pious hermit. While this tradition may not be strictly true, it perhaps is as veracious as any other Chinese fable accounting for the origin of tea: for as to who first found the leaf and brewed "the cup that cheers but not inebriates," history is altogether silent. On the first day of February last, there existed in stock in England alone 105,100,000 lbs. of Chinese tea, representing a value of nearly $40,000,000. The quantity exported from China to the United States, for the year ending June, 1874, was 49,831,800 lbs., representing a value of $21,212,334. These figures are sufficient to indicate the enormous commerce comprised under the name of the tea trade; but they do not by any means represent the proportions of the total tea traffic, since they relate to that of but one country. China tea is perhaps the best grown; but in South America it is superseded by the leaf of the *ilex Paraguayensis*, or Paraguay tea plant; and in Java and Sumatra, coffee leaves are greatly preferred by the natives. Among the other kinds of tea known are Labrador tea, made of the dry leaves of the marsh ledum (*ledum palustre*), indigenous to North America, Abyssinian tea or *chaat*, Tasmanian tea, or the dried leaves of various *myrtaceæ*, found in large quantities in Australia. Faham tea is the leaves of a fragrant orchid found in Mauritius; Appalachian, Oswego, Mountain, and New Jersey teas are all from plants found in the United States.



THE CULTURE AND PREPARATION OF TEA IN SIKKIM, INDIA.

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Sloe and strawberry tea are perhaps the best substitutes for the Chinese production. There are also Mexican tea, a Brazilian tea—the aromatic *capitão da matto*—a Santa Fé tea, Indian tea, Toolsie tea; beside tea made from the leaves of scores of other plants, however, unlike the above, have never come even into a limited use.

In the face of gigantic statistics relating to its consumption, and of the great profusion with which Nature has provided the herbs suitable for the beverage, it is a little startling to find that tea is, after all, a poison, one capable of producing functional nervous disarrangements when taken in excess. It exerts an astringent action; and by the presence in it of an organic substance, *theine*, it exercises its special influence. "In poverty-stricken districts," says Dr. Richardson, in "Diseases of Modern Life," "among the women who take tea at every meal, an extremely nervous semi-hysterical condition from the action of tea is all but universal. In London and other fashionable centers, in which the custom of tea-drinking in the afternoon has lately been revived under the old name of 'the drum' (kettledrum is the society name for these social parties in the United States), these same nervous symptoms have been developed in the richer classes of society, who, unfortunately, too often seek to counteract the mischief by resorting to alcoholic stimulants. "The maladies caused by tea are deficiency of saliva, destruction of taste for food, biliousness, nausea, nervousness (often extreme), and nightmare whenever sleep is obtained." A formidable indictment, truly, for the harmless looking and fragrant contents of one's tea caddy. It is more pleasant to contemplate the reverse of the picture, and agree with a Chinese writer that "drinking it tends to clear away all impurities, drives off drowsiness, removes or prevents headache," or with Dr. Edward Smith in his recent work on Foods, in which he says that the beverage stimulates respiration, and "powerfully promotes the assimilation and transformation of other foods."

To enter into all the varied details of tea culture would be far to transcend our present limits. An excellent idea, however, of a tea farm will be obtained from the large engraving given herewith, which is taken from photographs of new plantations near Dargeeling, in British Sikkim, India. Tea flourishes best on mountain slopes where there is plenty of rain, but where the water does not stagnate about the roots of the plant, and where the annual mean temperature varies from 68° to 76°. These conditions are fulfilled especially in those parts of Sikkim which are situated from 2,000 to 4,000 feet above the sea, and the tea produced is of exceptionally fine flavor. The tea seed is planted by drills in what are termed nurseries; and when the plant has grown to be 3 or 4 inches in hight, it is transplanted finally into a garden. The leaf is plucked by women and children from the middle of March up to November, when the cold season has begun, and cultivation commences. The leaves are then rolled into a form called a dullah; and after these have fermented and turned brown, they are broken up and placed in a bamboo vessel over a sharp, clear, charcoal fire until roasted. The tea then passes to women, who pick out all red leaves and stalks. It then goes to the sifter, who separates the different kinds of tea. After this it is again returned to another set of women, who fan out all chaffy leaves by shaking it up in a round shell bamboo basket. The tea is then heated over a slow fire, and finally packed for transportation. No. 1 of our engravings is a general view of the plantation; 2 represents the leaves being weighed; 3 shows the hands employed in plucking the leaf. In 4, the leaves are being rolled; in 5, they are represented in large baskets withering in the sun; 6 shows the rerolling operation by machine; 7, withering in the factory; and 8, a machine for sorting the various kinds.

Few articles of commerce are more adulterated than tea. The London *Times*, in 1873, published some interesting revelations on this subject, and once stated that, "out of twenty samples, nineteen were found to be adulterated with plumbago, lie tea, iron filings, and sand. Since tea naturally contains a large quantity of tannin, there are thus brought together the two chief constituents which enter into the composition of ink, and by appropriate treatment a bottle of good ink actually was made from the tea in question." The London *Medical Examiner*, of recent date, very fully examines the various adulterations of the Chinese leaf, and says that these, for the most part, consist in redrying and refiring exhausted leaves. It is quite impossible to tell to what extent this is done, as the leaves can be made to look as good as new, and can be mixed with fresh ones without much chance of detection. Another method, practised in Canton, is the production of scented and green teas from the leaves of other plants. Whole chops of tea, consisting of 1,000 packages each, and called Canton gunpowder tea, have been exported, composed entirely of rose leaves painted green. The facing powder used in these cases is Prussian blue and sulphate of lime or gypsum. Willow leaves are frequently employed as adulterants; and an ingenious fraud, capable of deceiving even experienced tea dealers, is perpetrated by boiling rice and dropping the conjee or rice water into tea dust. This done, it is impossible to tell the quality of the article until the liquor is distilled from it.

A wreck brings a great and profitable harvest to tea dryers. Several years ago, the steamer St. Petersburgh was lost with a cargo of tea, and after being immersed for sixty days the chests were regained. The tea was rather salty to the taste; but as many thousand barrels full were obtained, it is probable that it was all revamped and sold to the retail trade.

Three words as to making tea by way of conclusion, and these are: Don't boil it; to do so is a barbarism. Theine in tea, like caffein in coffee, is a volatile principle which boiling drives off, leaving only a decoction of the bitter astringent residue, for which we know no better name than liquid headache generator. It is a strong stomach that can withstand more than a pint of the simmered abomination, sold in most restaurants under the name of tea. Tea well made is fragrant, aromatic, and exceedingly grateful to the taste; tea badly made has a flavor like boiled brooms. The rule for making good tea is first to scald the teapot, put in the tea, pour on fiercely boiling water, cover tightly, and if green tea, serve immediately, or if black tea, stand near a fire for five minutes. Certainly no rule could be simpler than this; and yet in the average household, there is none for which the Irish handmaid entertains a more profound contempt.

NEW METHOD FOR THE DETECTION OF NICKEL IN THE PRESENCE OF COBALT.

BY MALVERN W. ILES. PH.B., SCHOOL OF MINES, COLUMBIA COLLEGE, NEW YORK CITY.

In October, 1875, I began comparative experiments upon various nickel and cobalt salts, in hopes of detecting some characteristic difference, which would serve for qualitative purposes. I was soon surprised at the intimate relationship existing between these elements; and although I was not led to believe that nickel and cobalt were one and the same element, as has been thought by some chemists, yet I will unhesitatingly state that a search for qualitative and quantitative methods for these metals has been as great a source of annoyance to chemists as was the discovery of these elements in an ore by any of the old German miners, who attributed their occurrence to the evil spirits *Kobold* and *Nick*.

The literature upon these metals alone would fill volumes; yet all that is known in regard to this subject has not yet been made public, since the metallurgical treatment of nickel and cobalt ores is kept in the greatest secrecy. Long before I had completed my researches into the literature of the subject, and before I had performed the various qualitative reactions suggested, I was overwhelmed with the magnitude of the undertaking. My investigations have, however, led to the discovery of a new and yet undescribed salt of nickel, eminently characteristic of this element. Its formation could, I think, be more advantageously applied upon a metallurgical scale than in the qualitative laboratory. The qualitative method which I suggest, which has been successfully used at the School of Mines for some time, may be stated as follows: Remove the metals precipitated by hydrochloric acid and hydrosulphuric acid as usual; then add ammonium chloride, ammonic hydrate, and ammonium sulphide; the precipitate may contain aluminic and chromic hydroxides, also zinc, manganese, iron, nickel, and cobalt sulphides. Treat the precipitate with dilute hydrochloric acid, and gently warm; all the metals will be dissolved as chlorides, except the nickel and cobalt sulphides, which will remain as a more or less granular black residue. In order to insure the complete removal of the other metals, especially iron, which would interfere with the subsequent proceedings, it will generally be found advisable to wash the black residue several times with warm dilute hydrochloric acid. The residue is next tested in a borax bead. If it is brown, the student may safely conclude the absence of cobalt, and only the presence of nickel.

Since, however, the beginner in qualitative analysis frequently mistakes a dark residue of iron sulphide, which often occurs at this point, mechanically enclosed in the separated sulphur, for a residue which contains nickel or cobalt sulphide, it is generally advisable to recommend that, in case a brown bead is obtained, to dissolve a small portion of the residue in dilute *aqua regia*, and test for iron by the addition of potassium ferrocyanide. In case iron has been found, the remaining residue is to be digested several times with dilute hydrochloric acid, until no reaction for iron is obtained or the residue completely dissolved. If a blue bead has been obtained, indicative of cobalt, then nickel is to be looked for in the following manner:

(*a*) Dissolve the black residue in as small a quantity of concentrated nitric acid as possible; evaporate almost to dryness (this step should not be overlooked, since the next step taken is the addition of ammonia, which would have to be added in considerable quantity if the nitric acid was not at least partially expelled). (*b*) Add ammonic hydrate until the nickel and cobalt hydroxides are dissolved. (*c*) Add glycerin, $\frac{1}{10}$ or $\frac{1}{12}$ of the volume of the liquid upon which the experiment is made. Heat until the solution has acquired a purple or rose tint. (*d*) Filter. (*e*) Add potassium ferricyanide in slight excess, and heat to boiling for a few minutes; a light red precipitate, or a white flocculent precipitate, which soon settles, indicates nickel. If the ammonia be quite strong, or if considerable has been added, boil several minutes. A few drops of dilute hydrochloric acid will shorten the operation; but its use is not to be recommended in a qualitative laboratory, since the students are too apt to continue adding the acid till acid reaction ensues, in which case the cobalt will be precipitated. Even a large amount of cobalt, treated as above, remains perfectly clear.

When potassium ferricyanide is added (*e*), the solution acquires a beautiful red tint, similar to the coloration produced when ammonium sulpho-cyanide is added to a ferric salt. When this red tint is very intense, it is very advisable to dilute the solution slightly, in order that the analyst may easily see through the liquid; and then, on heating, in case nickel is present, a cloudiness will occur at the top of the test tube, which soon spreads through the entire liquid; and then, on heating still further, distinct floccules will make their appearance, which settle readily, having no tendency to adhere to the sides of the test tube. In case nickel is not present, the liquid clears up considerably.

I have been greatly aided in studying the chemical changes that take place by Professors Gibbs and Genth's "Researches upon the Ammonia-Cobalt Bases," from which I take the following: "An ammoniacal solution of chloride or cobalt (also nitrate?) absorbs oxygen readily from the air, becomes at first brown, and then gradually passes through various shades of color to a deep red." This solution "leaves upon the filter a quantity of hydrate of sesquioxide of cobalt, which is sometimes almost inappreciable, sometimes in comparatively large amounts." The glycerin, I think, plays no important part until the addition of the potassium ferricyanide. Since, however, a large number of samples of glycerin contain some lime, which can easily be detected with the spectroscope, and also since the ammonic hydrate invariably contains some ammonium carbonate, there will be a slight precipitate of calcium carbonate, after the addition of the glycerin and the application of heat. We see, therefore, from the above that the filtration (*d*) has a two-fold object: First, the removal of $Co_2(HO)_6$, and second, the removal of $Ca\,CO_3$.

The facility with which alkaline solutions of many of the metallic protoxides, say Professors Gibbs and Genth, absorb oxygen from the air attracted the attention of chemists at an early period. The proto-salts of iron, manganese, and cobalt are particularly remarkable in this respect. The object, then, of the boiling (*c*) is twofold: 1. The separation of $Ca\,CO_3$. 2. The formation of purpero-cobalt.

"The salts of purpero-cobalt are often found among the direct products of the oxidation of ammoniacal solutions of cobalt. They are often formed from the salts of roseo-cobalt by heating or by boiling, or with strong acids, the cobalt passing, as we conceive, from one modification to another. The salts of purpero-cobalt are distinguished by a fine violet red or purple color, which is common to nearly all of them, and which is very different from the comparatively dull red of the salts of roseo-cobalt."—*Researches upon the Ammonia-Cobalt Bases.*

Professor Gibbs' explanation of the action of ammonia on a protoxide of cobalt may be briefly stated as follows: "The protoxide is converted into sesquioxide of cobalt, which, at the instant of its formation, unites with a certain number of equivalents of ammonia, so as to form an integral portion. The new base partakes. in some measure, of the properties of the alkalies, the peculiar character of the salts of cobalt being wanting."

There are various other elements that form compounds analogous to the ammonia-cobalt bases. For example, Claus obtained ammonia-rhodium and ammonia-iridium, bases corresponding to roseo-cobalt, and, like this, triacid bases. Professors Gibbs and Genth say: "We have made many experiment in this direction, without, as yet, interesting results. Iron and manganese promised to afford similar classes of compounds; yet, in their behavior towards ammonia and oxygen, the proto-salts of these metals exhibit no analogy to those of cobalt. With chromium, the case may be different; but we cannot as yet pronounce, with certainty, on this point. Experiments with nickel failed entirely, and yielded ammonia salts of the protoxide."

In regard to the precipitation of cobalt with potassium nitrite, Dr. Fleitman says (*American Chemist*, November, 1875, page 193): "In the case when less than 1 part cobalt in 100 parts nickel is present, the precipitation of the former by $K\,NO_3$ is by no means accurate." Professor Wolcott Gibbs says, in regard to this subject: "The complete precipitation requires 48 hours, and rarely succeeds, unless in experienced hands."—*Chemical News*, March 17, 1865, also *American Journal of Science and Arts*, January, 1865.

I have found, when the amount of cobalt is large, that 48 hours is not long enough. Yet this method of separating cobalt from nickel is the one upon which very great stress is laid by nearly all the writers on chemistry. It is the one placed in the hands of beginners in the science of chemistry. No one, however, seems to raise a cry of objection except the poor tortured qualitative student, who finds, at the expiration of the 48 hours, that something is wrong; no yellow precipitate has formed; and even if a yellow precipitate has formed, in the filtrate, when evaporated to dryness and the residue tested in a borax bead, very frequently a beautiful cobalt blue looms up, beautiful in itself, but most aggravating to behold at this stage of his expended patience!

The French Exposition of 1878.

A law has has been passed by the French Legislature, decreeing the opening of an International Exposition in Paris, on May 1, 1878, and the continuance of the same to October 31, of the same year. A commission has been appointed to make preliminary preparations; and of this, a sub-committee under M. Viollet-le-Duc, the celebrated French architect, was charged with the devising of a project for the grand buildings. M. Viollet-le-Duc's committee has reported as follows:

"Your sub-commission thought that it was necessary to have the covered space amount to 2,255,000 square feet in the Champ de Mars, and that it was proper to adopt rectilinear dispositions of the inclosure, forming a compact whole, which might be easily divided off according to the nature of the products exhibited in one direction and according to the nationality of the exhibitors in the other, a sort of Pythagorean table, upon which, on following one direction, a range of similar products might be inspected, while on taking an opposite direction to the first the nationalities would show their different merchandise. In the middle of this vast building are to be arranged saloons to receive an exposition of objects of art submitted by masters in every coun-

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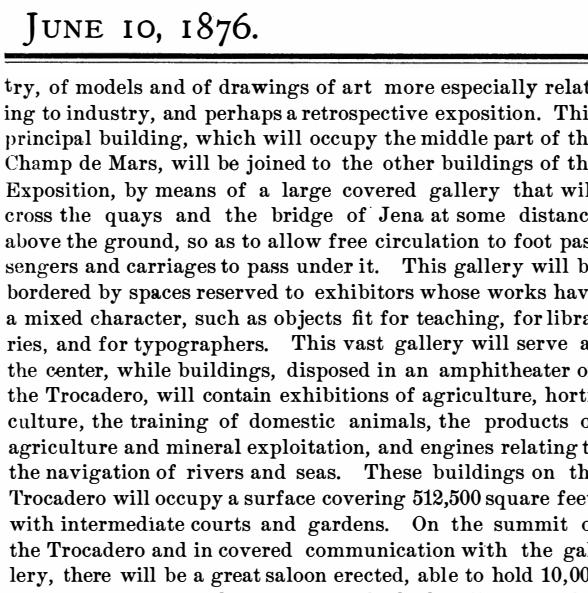
try, of models and of drawings of art more especially relating to industry, and perhaps a retrospective exposition. This principal building, which will occupy the middle part of the Champ de Mars, will be joined to the other buildings of the Exposition, by means of a large covered gallery that will cross the quays and the bridge of Jena at some distance above the ground, so as to allow free circulation to foot passengers and carriages to pass under it. This gallery will be bordered by spaces reserved to exhibitors whose works have a mixed character, such as objects fit for teaching, for libraries, and for typographers. This vast gallery will serve as the center, while buildings, disposed in an amphitheater on the Trocadero, will contain exhibitions of agriculture, horticulture, the training of domestic animals, the products of agriculture and mineral exploitation, and engines relating to the navigation of rivers and seas. These buildings on the Trocadero will occupy a surface covering 512,500 square feet, with intermediate courts and gardens. On the summit of the Trocadero and in covered communication with the gallery, there will be a great saloon erected, able to hold 10,000 persons, comprising the tribunes, and which will be intended for concerts, for testing the musical instruments, for public *réunions*, and for the solemnities of the opening and the distribution of prizes. Between the Military School on one side and the quay on the other and the buildings of the Champ de Mars, gardens will be planted, and will contain *cafés* and restaurants, none of which will be suffered to exist under any pretext within the inclosure itself of the palace. The rectilinear disposition of the roofs in plan and section for the palace of the Champ de Mars will have the advantage of making an economical structure, and of allowing the buildings to be erected in haste and to be pulled down in the same way, as well as to be used afterwards for other purposes, so that the sale of the materials after the close of the Exposition will be easy and profitable. These constructions should be in iron, filled in with bricks and masonry. As to the buildings of the Trocadero, they could in most cases be built in timber, as also the gallery of communication. This gallery, well constructed, should be a fine architectural work of an original aspect, particularly at its passage over the bridge, where it could partly be arranged with trusses, leaving the arches completely independent.

"The beautiful outlines of the Trocadero give us a reason for erecting picturesque buildings, which will be crowned by the grand saloon, from the top of the platform of which visitors will enjoy a ravishing panorama."

AN OLD PROBLEM.

In a recent letter a correspondent asked for an explanation of the method of drawing a circle tangent to any three given circles. Intending to refer him to some good treatise on practical geometry, we examined the principal ones, and found that they contained no mention of this question. On making further investigation, we ascertained that it was a celebrated problem among the ancient geometers, and was



subsequently solved by Vieta, and later by Sir Isaac Newton. It is contained in some foreign works on geometry, and a solution is given in Hutton's "Mathematical Recreations," which seems, however, to be incorrect. It is probable, therefore, that the solution is not generally accessible; and as the problem is unusually interesting and instructive, we lay it before our readers, in as simple a form as possible. The problem itself may be of little importance, but the principles upon which its solution depends are of general utility in geometrical constructions.

The construction in question is one of a class in which the solution is best obtained by indirect methods, changing the nature of the problem by successive steps in order to simplify it. As it is not at once evident what those steps should be, it will be advantageous to make the supposition that the problem has been solved, and see if some conditions can be obtained which may be fulfilled by construction. If such conditions can be discovered, it will, of course, be easy to make the required construction. It may be added that this method is of general application to all intricate geometrical problems.

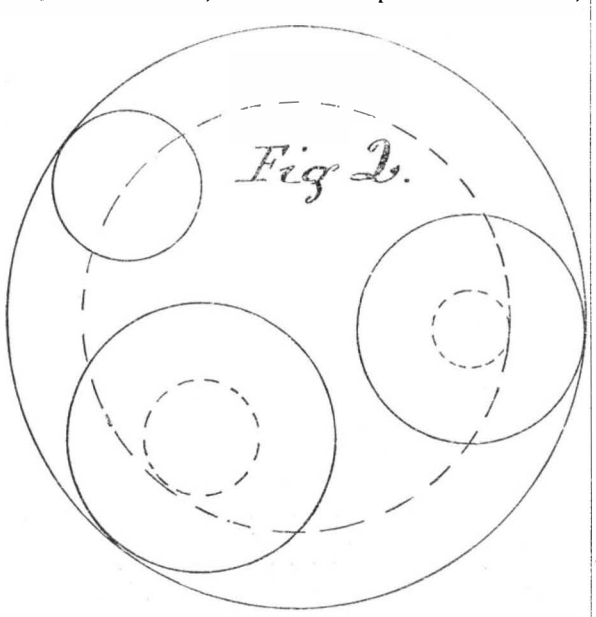
Referring to Fig. 1, the three given circles have their centers at A, B, C, with radii, A*a*, B*b*, C*c*. Suppose that D, the center of the required tangent circle, is known; it is evident that this will also be the center of a circle with radius, DF, passing through the center, A, of the smallest circle, and tangent to two circles with centers at B and C, and radii, BE, CF. Hence, by the use of these auxiliary circles, the problem can be changed into another, in which it is required to draw a circle through a given point, and tangent to two given circles. Suppose this to be done, and draw the line, GHN, tangent to the two auxiliary circles; draw also the line, CBG, through the centers of the auxiliary circles, the line, GEF, through the points of tangency of these circles with the required circle, the line, GAL, through the center of the small circle, and the radius, B*e*. Then, from the principles of geometry, we obtain the relations:

$$\frac{GC}{GB}=\frac{GF}{Ge}=\frac{GF\times GE}{Ge\times GE}=\frac{GL\times GA}{(GH)^2}$$

From these conditions we can find a point, L, in the circumference of the required circle, so that, if the circle is drawn through the points, L and A, and tangent to one of the auxiliary circles, it will also be tangent to the other; hence the original problem can be reduced to the case in which it is required to draw a circle through two given points, and tangent to a given circle. Suppose the circle with radius, CF, is the given circle, and that the required construction is made. Through the point of contact, F, draw the straight lines, LFN and AF; at N, draw a tangent, NM, to the given circle, produce the line, LA, to its intersection with the tangent at M; and from L, draw the tangent, LO, to the given circle. Then we will have the relations:

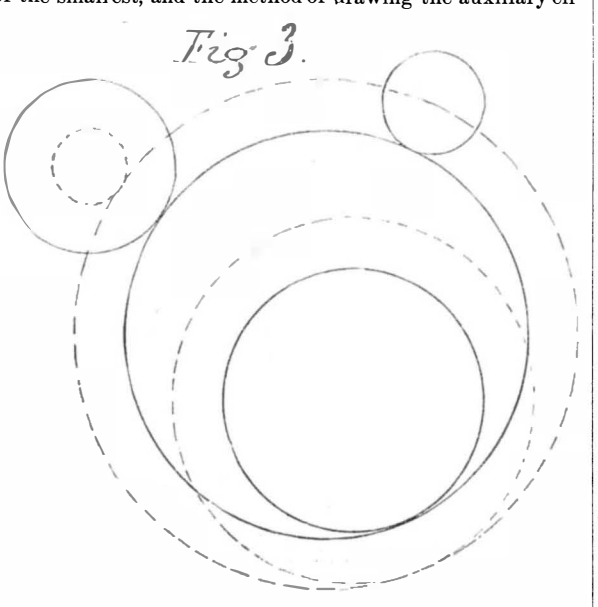
$$\frac{LA}{LF}=\frac{LN}{LM}, \text{ or } LA\times LM=LF\times LN=(LO)^2$$

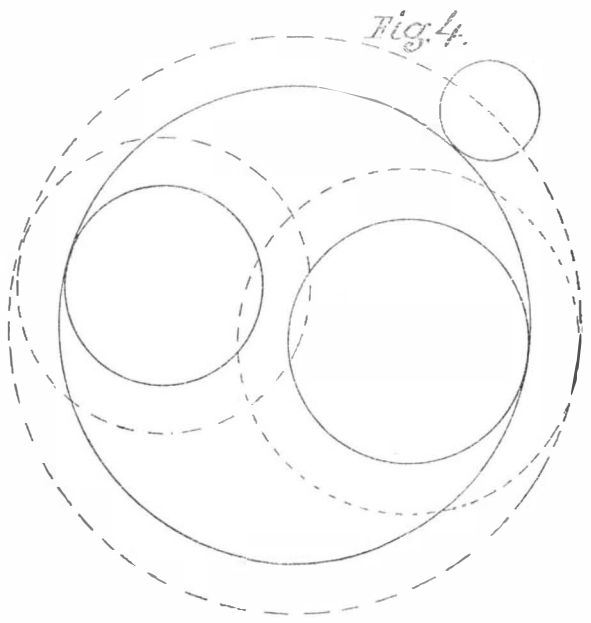
From these conditions, we can find the point of intersection,



M, the point of tangency, N, and the point of contact, F, so that the original problem is finally reduced to the simple one of finding the center of a circle which shall pass through three given points, A, L, F. The reader may find it profitable to verify the geometrical principles which have been stated above. We now pass to the method of making the construction, having shown the principles involved. All the auxiliary constructions are given in the figure, except such a simple one as the bisection of a line; but it has not been thought necessary to explain the methods of making them, as they will be found in an elementary text book. The reader will find it instructive to make the constructions as they are detailed below.

We have given the three circles in full lines, with centers at A, B, and C. It is evident that the problem admits of several solutions, as the tangent circle may touch the given circles externally, internally, or some of them internally and some externally. Several of these cases are illustrated in Figs. 2, 3, and 4. In any case, the first thing to do is to draw two auxiliary circles, whose centers are coincident with the centers of the two larger circles, and whose radii are such that a circle drawn from the same center as the required tangent circle, and passing through the center of the smallest of the given circles, will be tangent to the auxiliary circles. In Fig. 1, where the given circles touch the tangent circle externally, the radii of the auxiliary circles are the radii of the larger circles, each diminished by the radius of the smallest; and the method of drawing the auxiliary circles for different cases is illustrated in the other figures. In whatever manner the tangent circle is drawn, after the auxiliary circles are properly proportioned, the rest of the construction is the same for all cases; so that, in the remainder of the explanation, reference is made to Fig. 1.





Having drawn the auxiliary circles, with radii BE, CF, draw IH, tangent to both circles, and produce this tangent to its intersection with a line, CBG, drawn through the centers of the auxiliary circles. From G, the point of intersection, draw a straight line through A, the smallest of the given circles, and prolong it indefinitely. Next find the length of HK, the side of a square whose area is to the area of the square constructed upon GH as the line, GI, is to the line, GH. Then, considering GA to be one side of a rectangle whose area is equal to the square constructed upon HK, find the other side, GL; and the point, L, so determined, will be a point of the circle whose center we wish to find. We have now reached that part of the problem in which it is required to draw a circle through the points, L and A, and tangent to the circle whose radius is CF. Produce the line, LG, indefinitely; and from L, draw a tangent, LO, to the given circle. Find LM, the second side of a rectangle of which LA is the other side, and whose area is equal to the square constructed upon LO. From M, so determined, draw a tangent, MN, to the given circle, and connect the point of tangency, N, with the point, L. F, the point in which this last line cuts the given circle, is the point of contact of the given and required circles; so that it only remains to find D, the center of a circle passing through the points, A, L, and F.

We have been greatly interested in bringing the above problem to its present shape, in which it can be readily illustrated by a single figure, and many of our readers may be equally interested in repeating the construction. It will be necessary to use great care in all the steps, in order to secure satisfactory results. As it is not improbable that there are other solutions known to some of our readers, we may add that we will be glad to hear from any of them who think they can improve upon the method explained above.

Cleaning Silver Watch Dials.

Take about a teaspoonful of saltpeter and mix it with about two dessert spoonfuls of finely powdered charcoal; willow coal is the best. Let these be ground together with a little water on a piece of slate, with the blade of a knife; then by the aid of a camel's hair pencil, spread a portion of the mixture evenly over the surface of the dial, which must then be laid on a piece of charcoal; and with a blowpipe and the clear flame of a lamp or gas jet, it must be made just red hot, and kept so till the wet powder has ceased to fly about; it must then be thrown from the charcoal, hot as it is, into a mixture of sulphuric acid and water (in the proportion of about one fluid ounce of acid to three half pints of water); it will then have a snow-white appearance, and must be washed with brush and soap in clean soft water and put into fine sawdust, or, what is better, rose wood raspings, till quite dry.

New Drawing Instrument.

The Hartford Curve Scribe Company has recently exhibited to us an ingenious instrument for drawing curves and scroll ornaments, for use of designers, wood carvers, etc. It consists of an attachment to the ordinary compasses, in which is a small wheel, the periphery of which rests on the paper in place of the pen or pencil point. So long as the plane of the wheel is at right angles to its axis, it describes a complete circle when the compasses are turned; but the slightest inclination from that angle causes the line drawn to curve out or in, according to the direction and degree in which it is moved from the right angle. It is an efficient instrument for its purpose, and will be found a great help to pattern makers and designers. See advertisement on another page.

The East River Bridge.

The question of continuing work on the East river bridge will shortly be argued before the United States Circuit Court in this city. A lessee of one of the United States bonded warehouses, situated on the river side above the piers of the bridge, has presented a petition for an injunction, restraining the Mayors of New York and Brooklyn, the bridge company, and others interested from building the bridge "over the East River at the hight of 135 feet above mean high water, or at any other hight that shall obstruct, impair, or injuriously modify the navigation of said river." The petitioner declares that the structure would irreparably injure his business.

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Recent American and Foreign Patents.

NEW CHEMICAL AND MISCELLANEOUS INVENTIONS.

IMPROVED SCRAPER.

Prosper Coupal, St. Anne, Ill., assignor to himself and Joseph Dalpay, of same place.—While the scraper is being loaded, the handles are held in the ordinary position. When the scraper is to be unloaded the handles are raised, which causes the forward edge of the bottom to catch upon the ground, and, at the same time, causes rods to push back a catch plate which releases the rear edge of the bottom, and allows said bottom to revolve, discharging the load. As the bottom revolves, the handles are lowered, which brings the catch plate forward to receive and hold the rear edge of the bottom as it completes the half revolution, and, at the same time, the forward parts of the side edges of said bottom are caught and held by spring catches.

IMPROVED FRAME FOR EXHIBITING DRESS GOODS.

Lewis H. Springer, Claremont, Minn.—This is a base socket with an upright standard, carrying a curved cross beam with bent-up ends. It is intended to be moved on the counter, and to be moved to any part thereof, so as to shade and expose the goods to the best possible advantage.

IMPROVED GLOVE FASTENER.

William Hassall, New York city.—This consists of two plates, hinged to each other at their lower ends, slotted longitudinally, and having a ring passed through the said slots.

IMPROVED COUPON CUTTER.

Salem M. Schafer, New York city.—This consists of a shears with angle blade contrived to cut two sides of a right angle at one and the same operation, whereby the coupons may thus be cut off the bond in one operation, instead of two, as required in the use of common shears.

IMPROVED AUTOMATIC FAN.

Ervin G. Gollner and Emil Fretz, Dallas, Tex.—This consists of a fan attached to the pendulum of a clock mechanism. The pendulum is provided with pawls, in combination with the scape wheel, n such a manner as to give a quick strong movement to the fan.

IMPROVED BRICK KILN.

John W. Brown, Milton, Vt.—The construction here is such that, by fully opening flues, the moisture and steam can be quickly expelled, and then, by closing the said flues less or more, the heat, during the process of burning, may be controlled as may be desired.

IMPROVED PLATFORM SCALE.

Austin W. Comstock, Mount Pleasant, Iowa.—This is a new and ingenious mechanical device, which furnishes an apparatus easily adjusted, strong, durable, and not likely to get out of order. It is not practicable to explain the construction without drawings.

IMPROVED SHEARS.

Henry Dornburgh, Olmsteadville, N. Y.—This consists of a bar for the support of the pivot, sustained on one of the blades outside of the other blade, so that the pivot has a bearing at each end. The strain is thus applied in the middle, in such a manner that, in connection with broad bearings, the blades are prevented from opening laterally along the edges, as they do when the pivot goes through one blade and screws into the other.

IMPROVED OIL TANK.

John C. Chadwick, Baltimore, Md.—This invention relates to an improved construction of oil cans for grocers and other retailers of oil, which can is adapted to receive the contents of one or more barrels, and affords greater facilities for cleaning out the tank, by reason of a hinged segmental cover upon the rear upper portion of the can, and by reason also of the detachable character of the hood.

IMPROVED PENCIL ATTACHMENT TO SLATES.

William E. Thomas, Ford's Store, Md.—This invention is a tube, open at its ends, to receive the pencil, and hinged to a rod attached to one of the bars of the slate frame, which latter is recessed to accommodate the tube. When the pencil is required for use, the tube is turned out of the recess, but otherwise the pencil is retained in the tube by reason of the ends of the latter abutting the end wall of the recess.

AUTOMATIC AIR VENT ATTACHMENT FOR BUNGS.

James Talley, Jr., Kansas City, Mo.—The invention relates to an automatic vent tube, having certain peculiarities of construction, and a bung provided with a recess or cavity in its top portion to adapt it to protect the upper projecting end of the vent tube, the two being permanently attached, thus forming a combined bung and vent.

IMPROVED SHOE FASTENING.

John M. Cayce, Franklyn, Tenn.—This latchet is formed essentially of two metal plates, one of which is hook-shaped, to adapt it to catch up a button attached to the opposite flap, while the other is pivoted to the hook, and so constructed that, when adjusted in a certain position, it will prevent the hook becoming accidentally disengaged from the button.

IMPROVED PAPER JEWELRY.

Frederick W. Seidewitz, Baltimore, Md.—The object of this invention is to provide a cheap form of jewelry emblems and badges for temporary use, which, while presenting to the eye all of the appearance of the precious metals, are of very cheap production. It consists in ornamental devices embossed and stamped out from thin, gilded paper, and provided with a pin fastened in a fibrous disk, which is cemented to the back of the design.

IMPROVED METHOD OF ROASTING COFFEE.

Joseph B. Underwood, Fayetteville, N. C.—The object of this invention is to improve the quality of roasted coffee, and to obviate, to a great extent, the loss in weight; and it consists in a method of roasting coffee, whereby the volatile products are utilized by being conveyed to a closed communicating chamber for cooling the coffee, wherein the said flavoring and aromatic exhalations are restored to the coffee as it is cooled, and the roasted coffee preserved and rendered less susceptible to the damaging effects of the atmosphere.

IMPROVED PLUG TOBACCO BOX.

Benjamin F. Jaques, Petersburg, Va.—The box is so constructed as to permit the tobacco plugs contained therein to be conveniently inspected without the necessity of removing them. The box is rectangular and preferably oblong in shape, having flanged sides and open ends, one of which latter is hinged or removable. The tobacco is exposed to view the whole length of the box, and also at its ends, and the cover may be readily removed to allow insertion or removal of the tobacco.

APPARATUS FOR HEATING AND MIXING OLEAGINOUS SEEDS.

William M. Force, Newark, N. J.—This is an apparatus for mixing oleaginous seeds, so that the seeds, crushed or otherwise, are properly heated, mixed, and tempered for the expression of the oil. The invention consists of a series of spirally arranged revolving stirrer pipes that are supplied with steam from a central upright shaft.

IMPROVED TILLER HOLDER ATTACHMENT FOR VESSELS.

William E. Thomas, Ford's Store, Md.—In this attachment a single block is fixed to the forward end of the tiller and a double block near its middle, the shears in the latter being situated side by side, transversely. On each side of the rudder, single blocks are lashed to staples on the deck. A rope attached to a staple, fixed to the tiller, below the double block, runs, successively, through one of the blocks on the deck, the double block, (around the sheave on the same side), the single block at the forward end of the tiller, the double block (around the opposite sheave), and the opposite bloce on the deck; its end, then passing forward, is belayed to a cleat or pin on the tiller. By turning a set screw in the block on the forward end of the tiller, pressure is applied to the rope and the tiller fixed in any desired position.

IMPROVED BEE HIVE.

Christopher Ellis, Level Land, S. C.—The object of this invention is mainly the production of a hive adapted for the application of active and efficient means of preventing the ravages of the moth, without, at the same time, destroying or injuring the bees. To this end, the hive is provided with a broad chamber or box, which is separate and preferably detachable, and a perforated metal plate is applied to an opening formed in the bottom board. The moth egg or young worm is destroyed by pouring hot water between the contiguous sides of the hive and the brood chamber, the perforated plate allowing the water to escape from the hive without drowning the bees, or otherwise injuring them. The invention likewise embodies certain other features of construction and arrangement of parts whereby advantages are attained in hiving, handling, and transporting bees.

PROCESS FOR SEPARATING WOOL FROM MIXED FABRICS.

Dr. Joseph Wilkins, Baltimore, Md.—This invention relates to an improved process for separating wool fiber from its admixture with cotton for the purpose of utilizing the wool mixed with cotton in old rags. The improvement consists in the use with any of the active acids (SO_5, HCl, and NO_5) of chromic acid or any of its compounds, from which it may be liberated by the action of the other acids, which chromic acid, by reason of its affinity for the albumen of the wool, prevents the injurious action of the more active acids, and, while permitting the elimination of the cotton by the well known action of the actual acids, prevents the bad effects of the same upon the wool.

IMPROVED BEER TAP.

George C. Drinen, Brooklyn, N. Y.—The novel feature in this tap consists in making the valve cylinder independent of the bush, and removable without detaching the latter. This allows the barrel to be easily cleansed.

IMPROVED ICE CREAM FREEZER.

David J. Rogers, Bardstown, Ky.—This invention consists of a handle with three holes to fit over the square end of the dasher shaft. When the latter is inserted into the hole nearest to the middle of the handle, a projection on the latter strikes upon a projection on the upright sleeve of the can cover, and prevents the dasher from revolving independently of the can, which does not happen when the end of the shaft fits in either of the other holes. On the edge of the can cover is a curved catch, which, in conjunction with a hinged stop on the cross bar of the tub for the freezing material, allows the can to rotate but in one direction.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED DEVICE FOR GREASING AXLES.

Alfred G. Curtis, Ottawa, Ill.—This invention relates to an improved construction of devices for lubricating the skein of vehicle axles, and it consists in a filling tube and a plunger fitting therein, which, together, are employed for charging a longitudinal reservoir in the skein with grease, the said reservoir running the entire length of the skein and opening through a slot upon the surface of the skein, by means of which construction the axle is rendered self-greasing until the reservoir is exhausted. The latter may be refilled without taking off the wheel.

IMPROVED FOUR-WHEELED VEHICLE.

William Buckeridge, Port Huron, Mich.—This invention is an improvement in the class of four-wheeled vehicles provided with a jointed reach to facilitate turning within narrow limits. The front and rear axles are connected by a jointed reach without the aid of any supplementary device, and the body of the wagon is pivoted to the front axle, and supported on the rear axle by means of friction rollers, so that it moves freely thereon whenever the wagon is turned to the right or left.

IMPROVED ARCH BAR FOR FIRE PLACES.

Isaac McCown Wickersham, Harrodsburg, Ky.—The ordinary support for the brick arch of chimney fire places is a flat iron bar, made either straight or slightly curved. The chief objection to this—apart from the total lack of ornamental design or configuration—is the liability of obstruction to the passage of smoke by reason of the thickness of the brick arch or wall resting on the bar. To obviate this objection, and also secure certain other advantages, the inventor employs an arch bar formed of a vertical front plate, having a horizontal top flange to support the brick wall, and of a back plate, projecting upward and inward from the lower edge of the front plate, at an angle of about 45°, for the purpose of directing the smoke.

NEW HOUSEHOLD INVENTIONS.

IMPROVED WASHBOARD.

John S. Washburn, Jersey City, N. J.—This consists of a series of round bars, around which a strip of wood is passed and fastened. The strip being bent upon a curve will not be liable to break or crack, and thus will not cut nor tear the clothes.

IMPROVED HANGING SHELVES.

Richard St. Leger Brodrick Chinnery, Kankakee, Ill.—These are so constructed that they may be lengthened and shortened to adjust it to the breadth of the place where they are to be hung.

IMPROVED CHAIR AND LOUNGE.

James W. Barnes, Navasota, Texas.—This invention relates to certain improvements in invalid chairs, designed more particularly for persons afflicted with pulmonary affections and with weakness or curvature of the spine. It consists mainly in the attachments to and adjustments for the back of a chair; the first of which consists of adjustible and detachable and horn-shaped supports, which are adapted to fit beneath the armpits and sustain the weight of the patient, and the second of which consists in the adjustment of the back of the chair to facilitate the getting out of and into the same.

IMPROVED STOVE KNOB.

Ralph Strickland, Albany, N. Y.—This invention consists of a knob made of a shell of thin metal filled with plaster of Paris or other suitable non-conducting material. The shell is in two parts, a body and a cap, through both of which a screw passes centrally, serving to attach the cap to the body, and the knob to the stove door, by means of a nut on the inside of the latter.

IMPROVED BED LOUNGE.

William E. Buser, Chillicothe, Ohio.—The lounge has a removable top and a hinged adjustable bottom, which latter may be raised or lowered at will. The said bottom is supported upon its hinges when raised to a horizontal position, and the hinges lie flat when the bottom is lowered. The head of the lounge is also hinged, and may be adjusted in position to correspond with the bottom.

IMPROVED HOT AIR GLOBE AND SHADE HOLDER.

Leander E. Fish, Washington, D. C.—This invention is designed to impart steadiness to the flame of argand gas burners which are used with cylindrical chimneys, and more particularly to those burners which are exposed to drafts of air, as street lamps and outdoor lights. The invention consists in the application of an outer globe or cylindrical chimney to the chimney proper, which outer globe is drawn inward at the bottom to form, with its holding device, a closed hot-air chamber around the chimney proper, so that the air which feeds the flame is compelled to pass down the annular space between the two chimneys, or the chimney proper and the globe, before it reaches the flame, whereby the air is fed to the flame hot, which is an advantage, and the flame is completely protected from flickering or blowing-out even, even when exposed to a heavy wind. The invention also further consists in the clamping device for holding on the outer globe or chimney with an airtight connection, and also in the construction and arrangement of a shade holder attached to the same globe-holding devices.

IMPROVED SHUTTER FASTENER.

Joshua E. Brooks, Baltimore, Md.—This invention consists of two tumbler latches in a metallic box inserted in the window sill, and which are pressed by pivoted springs against a spear-headed catch, fixed to the shutter. The tumbler latches are connected by a rod which pivots in opposite ends of each. The tumbler latches are released from the spear-headed catch by the aid of a handle which passes up from one of the latches, through a curved slot in the metallic box.

STOPPER FOR WASH BASIN OVERFLOW OPENINGS.

Ezra Webb, New York city.—This is a plate provided with a number of small projections to enter the holes in the overflow opening in the side of the wash basin. The object is to prevent the outflow of sewer gas at that point.

NEW AGRICULTURAL INVENTIONS.

IMPROVED CLOD CRUSHER.

John M. Crockett, Dallas, Texas.—This implement consists of two series of flat parallel bars, which are curved or bent twice, and attached at their ends to the same cross bars. The bends of the bars of one series are at such points as bring them out of alignment with those of the others; and hence, when a clod escapes being crushed by a bar of one series, it will ordinarily pass laterally under the next bar, and thus be subjected a second time to a crushing action. The clods are thus broken up, and the land leveled. The implement is light, cheap, strong, durable, and effective.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED PERPETUAL AUTOMATIC CALENDAR ATTACHMENT FOR TIME PIECES.

Miner H. Paddock, East Clarkson, N. Y.—The calendar, with its attachment, is arranged for the days, weeks, and months, with indicating hands for each, and, while being practically automatic, is also perpetual: that is to say, the mechanism is such as to compensate for the irregular number of days occurring in the different months, by a system of skipping, whereby a single day wheel of 31 subdivisions is made to indicate, successively and in proper order, the different number of days (28, 30, or 31) as they occur in the successive months of the year.

IMPROVED WATER COIL STEAM GENERATOR.

Benjamin S. Benson, Baltimore, Md.—This invention relates to a novel construction of steam generator adapted to be also used as a boiler. It belongs to that class of generators in which a cylindrical coil of pipes is employed above a furnace or heating chamber, to generate the steam; and it consists in the construction and arrangement of the coils, which are made to project at one point beyond the containing shell, and are provided, upon the outside of the shell, with peculiarly constructed elbow joints, which permit the ready removal of the deflector or worn-out sections of the coil, and also give easy access to the pipes for cleaning out the same. The invention also consists in the peculiar construction and arrangement with the coils of a thermostat or automatic relief chamber for the surplus water not evaporated by the generator.

SPRING POWER AND TREADLE FOR SEWING MACHINES.

James H. Morley, Holyoke, Mass.—This is a combination of foot power and spring power. One of the treadles works the machine directly, and the other is connected to the spring power for winding it up.

IMPROVED ROTARY ENGINE.

John R. Peters, Dover, N. J.—This consists of plain flanges attached to the hub and extending out as far as the pistons move, with stationary packing rings pressing on the edges of the flanges and against the case. This is claimed to prevent the radial end wear of the pistons by the packing rings and the loss of steam through the necessary clearance between the inside edges of the circumference of the flanges and the case. The invention also consists of compound pistons, consisting of two or more plates in each groove in the hub, the ends and tops of which may be so formed as to prevent serrated edges, and constitute with condensed steam what is called water packing.

IMPROVED ROLLER GAGE FOR SAWMILLS.

Aaron Reppard, Savannah, Ga.—An adjustable roller guide is employed, on the side of which the boards are cut, with a shifting lever and a scale for setting it for boards of any thickness. Said roller is located just in advance of the saw, so that, by setting the log against it, every board will be gaged exactly alike as to thickness. The roller gage is mounted in a bracket, which slides on the bed piece, and the lever is connected to it by a link, and to the bed piece by a bracket.

IMPROVED TYPE WRITER.

Philander Deming, Albany, N. Y.—The object of this invention is to so improve the type writer that it may be made available in an effective manner for short hand reporting, and that the speed of the same in copying common writing may be considerably increased. The invention consists of a double escapement in connection with the rack bar of the carriage of the printing cylinder, the escapement being operated by an anvil and key, that may be brought in connection with the space key.

BOILER FEED WATER HEATER AND REGULATOR.

Frank W. Keys, New York city.—This consists of a couple of tanks, with water supply and boiler connections, and with valve mechanism, by which they are alternately opened to exhaust and fill. They are in communication with the boiler, the pressure being balanced. The invention also consists of another tank in connection with the two first-mentioned, to receive the water before it enters the others, and also to receive the exhaust steam for heating the water.

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Business and Personal.

The Charge for Insertion under this head is One Dollar a Line for each insertion. If the Notice exceeds Four Lines, One Dollar and a Half per Line will be charged.

Agricultural Implements and Industrial Machinery for Export and Domestic Use. R.H. Allen & Co., N.Y.

For Bolt Forging Machines and Power Hammers, address S. C. Forsaith & Co., Manchester, N. H.

Owners of Steam Engines—We guarantee 25 per cent extra power or an equal saving in fuel, by applying the Ransom Syphon Condenser. T. Sault, Consulting Engineer, General Agent, New Haven, Conn.

For Sale or Royalty—Cotton Stalk Puller, patented April 11. Address T. P. O'Connell, San Antonio, Tex.

Rubber Hydrant Hose, Hose Pipes and Couplings, best quality. Send for Prices to Bailey, Farrell & Co., Pittsburgh, Pa.

Wanted—Situation as Supt. or Foreman of Machine Works or Shop, by Machinist of 22 years' experience. Address Machinist, P.O. Box 383, Chicopee, Mass.

"Dead Stroke" Power Hammers—recently greatly improved, increasing cost over 10 per cent. Prices reduced over 20 per cent. Hull & Belden Co., Danbury, Ct.

Driving Belts made to order, to accomplish work required. Send full particulars for prices to C. W. Arny, 148 North Third St.. Philadelphia, Pa.

Power & Foot Presses & all Fruit-can Tools. Ferracute Wks., Bridgeton, N.J. & C. 27, Mchy. Hall, Cent'l.

Johnson's Universal Lathe Chuck—Awarded the highest Premium by the Franklin Institute of Phila., for "Durability, Firmness, and adaptation to variety of work." Lambertville Iron Works, Lambertville, N. J.

Metallic Letters and Figures to put on Patterns of Castings, all sizes. H. W. Knight, Seneca Falls, N.Y.

Wanted—A means of Waterproofing Manilla Paper at a cost not exceeding 2 or 4 cents a lb. Address Chas. R. Chute, Minneapolis, Minn.

We beg to call the attention of our readers to the advertisement of Geo. W. Read & Co., No. 200 Lewis St., where the largest assortment of Rare and Fancy Woods for amateur workers is constantly to be found.

Safety and Economy—Eclipse Sectional Steam Boiler. First Class references. Lambertville Iron Works, Lambertville, N. J.

Woman's Shoes—Patent for Sale, either whole or State Rights. Address C. Steckel, 199 Allen St., N.Y.

To Umbrella & Parasol Makers—Improvement in Handles for Sale. Address N. P. Fassett, Elmira, N.Y.

Water Wells—Wanted descriptive circulars, best apparatus for boring or driving, and best terms to agent. W. P., 1407 Ripley St., Davenport, Iowa.

Engine Builders and Mill Furnishers, send Circulars or Card to Benson Brothers, Centralia, Ill.

For Sale—35 in. 16½ ft. Lathe, $400; 18 in. 10 ft. do., $125; 15 in. 8 ft., $100; 19½ in. 7 ft. Stover do., $215; 9 ft. Planer, $400; 6 ft. Planer, 325; 12 in. Slotter, $390; Profiling Machine, $250. Shearman, 45 Cortlandt St., N. Y.

Lawn Mowers for Hand, Pony, or Horse—Prices reduced. Largest stock in the city. A. B. Cohu, 197 Water St., New York.

Wanted—25,000 lbs. 2nd hand light T rail. E. B. Seeley, Bowling Green, Ky.

For Sale—Complete outfit of machinery for the manufacture of cotton waste, cost $2,200. Price $700. Forsaith & Co., Manchester, N. H.

For Sale—24 in. x24 ft. Lathe, with Chuck; two 18 in. Lathes; one 7 ft. x24 in. Planer; two 8 in. Shapers. E. P. Bullard, 48 Beekman St., New York.

The Photo-Engraving Co. have been obliged to remove from 62 Cortlandt St. to a larger building at 67 Park Place. Their Relief Plates for Newspaper, Book, and Catalogue Illustrations are rapidly taking the place of Wood Cuts and are unsurpassed. See advertisement in another column of this paper.

For the best Patent Self-Opening Gates for Carriages, in any Style of Wood or Iron, address Cottom & Co., Dayton, Ohio.

400 Machines, new and 2d hand, at low prices, fully described in our printed list No. 6. Send stamp, stating just what you want. Forsaith & Co., Manchester, N. H.

Split-Pulleys and Split-Collars of same price, strength, and appearance as Whole-Pulleys and Whole-Collars. Yocom & Son, Drinker St., below 147 North Second St., Philadelphia, P.

The Bastet Magnetic Engine for running Sewing Machines, Lathes, Pumps, Organs, or any light Machinery, 1-32 to ½ horse power. Agents wanted. Address with stamp, 1,113 Chestnut st., Philadelphia, Pa.

The French Files of Limet & Co. have the endorsement of many of the leading machine makers of America. Notice samples in Machinery Hall, French Department, Centennial Exposition. Homer Foot & Co., Sole Agents, 22 Platt St., New York.

First class Amoskeag Steam Fire Engine for Sale, 2d hand, $1,200. Forsaith & Co., Manchester, N.H.

Trade Marks in England.—By a recent amendment of the English laws respecting Trade Marks, citizens of the United States may obtain protection in Great Britain as readily as in this country, and at about the same cost. All the necessary papers prepared at this Office. For further information address Munn & Co., 37 Park Row, New York city.

Shingles and Heading Sawing Machine. See advertisement of Trevor & Co., Lockport, N. Y.

For Sale—Sturtevant No. 7 Hot Blast Apparatus, $400. Forsaith & Co., Manchester, N. H.

Solid Emery Vulcanite Wheels—The Solid Original Emery Wheel—other kinds imitations and inferior. Caution.—Our name is stamped in full on all our best Standard Belting, Packing, and Hose. Buy that only. The best is the cheapest. New York Belting and Packing Company, 37 and 38 Park Row, New York.

Steel Castings, from one lb. to five thousand lbs. Invaluable for strength and durability. Circulars free. Pittsburgh Steel Casting Co., Pittsburgh, Pa.

For best Presses, Dies, and Fruit Can Tools, Bliss & Williams, cor. of Plymouth and Jay, Brooklyn, N. Y.

For Solid Wrought-iron Beams, etc., see advertisement. Address Union Iron Mills, Pittsburgh, Pa., for lithograph, &c.

Hotchkiss & Ball, Meriden, Conn., Foundrymen and workers of sheet metal. Fine Gray Iron Castings to order. Job work solicited.

For Solid Emery Wheels and Machinery, send to the Union Stone Co., Boston, Mass., for circular.

For Sale—2 Hunneman Hand Fire Engines with Hose Carriage, second hand, 5½ in. cylinder, 15 in. stroke. Price, each, $425. Forsaith & Co., Manchester, N. H.

Hydraulic Presses and Jacks, new and second hand. Lathes and Machinery for Polishing and Buffing Metals. E. Lyon, 470 Grand Street, New York.

Spinning Rings of a Superior Quality.—Whitinsville Spinning Ring Co., Whitinsville, Mass.

For best Bolt Cutter, at greatly reduced prices, address H. B. Brown & Co., New Haven, Conn.

Diamond Tools—J. Dickinson, 64 Nassau St., N. Y

Temples and Oilcans. Draper, Hopedale, Mass

Hand Fire Engines, Lift and Force Pumps for fire and all other purposes. Address Rumsey & Co., Seneca Falls, N.Y., U.S.A.

See Boult's Paneling, Moulding, and Dovetailing Machine at Centennial, B. 8-55. Send for pamphlet and sample of work. B. C. Mach'y Co., Battle Creek, Mich.

Notes & Queries

R. R. will find directions for tempering rock drills on p. 202, vol 31.—R. N. will find directions for calculating the strength of boilers on pp. 116, 165, vol. 28.—J. C. N. will find a description of the speed indicator for railway trains on p. 271, vol. 33.—R. N. will find a recipe for lemon sugar on p. 378, vol. 30.—B. & S., W. C. J., F. H. S., M. F., H. D., and others, who ask us to recommend books on industrial and scientific subjects, should address the booksellers who advertise in our columns, all of whom are trustworthy firms, for catalogues.

(1) A. C. H. asks: What is the best cement to resist the action of bisulphide of carbon? A. One of the best cements for this purpose is a solution of glue in warm dilute glycerin.

(2) F. B. says: Our schoolhouse is 30 x 50 feet on the ground, with only one floor. The ground is clayey and hard to drain. The frost raises it very badly. Is it practicable to set it on iron posts in such a way that the frost will not move it? A. Under each post of the building, place a timber post of good size, extending into the ground about five feet, and foot it upon the middle of a mudsill, of the same size and eight feet long, laid horizontally. Secure the foot of the post to the sill by an iron clevis bolted through the post, and provide a timber brace upon either side, from the post to the end of the mudsill. In filling in the trench, let the filling around the post be of large stone. If you are willing to take still greater precautions, you can lay another mudsill, at right angles to the one above described, to each post, and brace it in the same manner.

(3) E. P. R. says: I have a roof 16 x 24 feet, with a pitch of 3 feet, covered with shingles. It leaks badly. Is there anything that can be applied so the shingles that will make a perfect roof? A. The roof (about 1½ inches to the foot) is too flat. Elevate it so as to give a pitch of 6 inches to the foot, and then ordinary repairs will make it tight.

(4) B. J. M says: I want something to elevate as much as 1½ tuns freight about 20 feet, that one man can handle. A. A differential pulley block and chain will answer your purpose. They may be obtained from any machinists' supplies store.

(5) A. P. McC. asks: How can we ventilate our schoolhouse? It is heated by steam through coils of pipe around the sides of rooms. The building is of brick; and there are 20 rooms, each about 30x60 feet. A. Without plans of your building we cannot answer you specifically; but we would suggest generally the introduction of fresh air upon the coils of heating pipe, in such a manner as not to create drafts, and its discharge at the ceiling on the opposite side of the room.

(6) G. J. B. says: A roof leaks; it is of galvanized iron, and has been on several years. When I purchased the house, I was advised to cover the iron with two or three coats of a mixture of coal tar, Portland cement, and lime, and did so, at a cost of $50. I find, however, that the cement and lime get washed away, and that the cure is only partial. The iron is very good except in spots. How can these leaks be stopped? A. The iron is probably in large sheets, without the proper allowance for contraction and expansion; and this has opened the joints. A good roofer should be able to scrape all those places bare and clean and solder them tight, if the iron is not too much rusted away. In this way it might be made to serve a year or two; but the best job would be to put on a new tin roof in small sheets.

(7) H. asks: 1. If the Rumford method cannot be applied to show how much more light is concentrated upon a given surface by a concave reflector placed behind an artificial light than would be received from the same light at the same distance without the reflector, then by what process can the question be determined? A. The best way to find the utilizing power of concave mirrors is first to determine the loss of light by reflection of the material of which the mirror is made, then its size, its curvature, and the surface section of the bundle of parallel rays. 2. Is the following a correct rule to ascertain what proportion of light from a spherical source (a round charcoal set aglow, for instance) will fall upon a page of a given size? "Compute the surface measurement of a sphere whose diameter is twice the distance of the page from the flame, and the proportion which a page of a given size bears to the entire surface of the sphere will be the proportion of the whole amount of light falling upon the page, provided the page is held at right angles to the rays of light" If the rule is as stated, to what extent should it be modified when applied to a flat flame? A. The rule is correct, and need not be modified for flat flames, as such flames give the same amount of light in all directions, either from the edges or from the flat surface: flames being perfectly transparent for the light of other flames, and every part of a flame transparent for every other part of the same.

(8) H. asks: 1. With two lamps, which are proved by the Rumford or any like method to emit equal quantities of light, as a basis for a test, can the Rumford method be applied to test the utilizing power of concave mirrors by placing one of the lamps before a concave mirror, in its principal focus, and then varying the distance of the two lights from the screen until the shadows are sensibly equal in density? A. The method proposed could not give correct results, as the reflection from a concave mirror introduces complex circumstances, which make the comparison with a simple lamp impracticable. 2. Will the law of inverse squares apply to determining how many lamps, at the same distance, would be required to equal the amount of light thrown upon the screen by the lamp placed before the reflector? A. As soon as you place the lights in the focus of a concave mirror, you make the reflected rays parallel, and the law of inverse squares is no more applicable, being based on the divergence of rays from a point. 3. Will a test with the lights at any distance from the screen indicate with accuracy the relative utilizing power of the reflector, no matter what the distances? A. In order to determine correctly the relative utilizing power of reflecting surfaces, the only correct method is to use plane reflectors. 4. Can the photometric method be applied to make the same tests? A. The ordinary photometric method is the best for the tests in question, provided concave reflectors are excluded.

(9) J. G. C. asks: 1. Is any form of galvanic battery patentable? A. Yes, any new and useful form. 2. Can carbon plates for batteries be made out of plumbago? A. Yes. 3. Which is the best of all wood for insulation? A. The driest wood is the best. 4. Will oiling or polishing impair its insulating properties? A. No.

(10) I. E. T. asks: 1. Does the conducting power of a lightning rod depend on its surface or the area of its cross section? A. The latter. 2. Is there any gain in increasing the conducting power of a rod, without increasing the number of points? A. Yes, up to a certain point. 3. Is copper any cheaper for lightning rods than iron? A. No. 4. Why are iron wires so extensively used for telegraph lines? A. Because they are stronger.

(11) J. F. A. says: Please let me know the best method of case hardening thin steel plates so that they will not crack, twist, or bend in hardening. A. Cool them off between two flat gratings of cast iron, having small surfaces of contact.

(12) G. W. C. says: I was running a locomotive engine, when the firebox gave way. She had a solid gage of water in the boiler; but the crown and flue sheets sprang from the sides, and her flues were collapsed. She was carrying 135 lbs. pressure at the time. She had been known to stand on a grade for twenty minutes at a time before; and she would show water at the bottom cock, with a good injector at work all the time. I contend that the water getting low so often weakened the boiler, which, carrying a heavy pressure of steam, could not stand any longer. I also think that, if she had not been running at the time, the boiler would have exploded; but as she was pulling a train, a strong draft passed through the flues and helped to resist the pressure of steam. A. The boiler was, no doubt, weakened from the wide range of temperature, and therefore of expansion and contraction, which necessarily follows from letting the water get so low as to require to stand still on the road to fill up. Under such conditions, the destruction of the strength of the boiler is very rapid. Your idea as to the draft through the flues resisting the pressure is erroneous.

(13) J. M. M. says: I turned a paper cal nder roll so that it ran perfectly true. I then applied an emery wheel to finish with; but before the wheel had gone across the face of the roll, the roll ran out of true about $\frac{3}{64}$ inch. The lathe center ran true, the wheel post was firm, and everything else about the lathe was right. Why did the roll run out? My theory is that, in pressing the roll, the shaft was sprung; and in turning the paper off, the shaft sprung back, thus throwing the roll out of true. A. Your theory is probably a correct one.

(14) H K. S. asks: 1. Would even a good lightning rod contain one of the heavier charges of lightning, such as would shiver a good sized tree to pieces? A. Yes. 2. What would you consider a good rod? A. An iron rod half an inch in diameter.

(15) P. C. C. asks: I have a rotary steam engine running at 4,000 revolutions per minute. The piston is 1x1¼ inches. I hold 100 lbs. pressure on piston of engine. How many horse power has this engine? A. The horse power of rotary engives varies too much to admit of calculation, a remark which applies equally to consumption of steam, and hence to size of boiler.

(16) R. D. W. says: We are having some trouble in making a quarter twist belt run. We have been running a 6 inch rubber belt which ran all right; but now we wish to change to a 6 inch leather belt, which will not run anywhere with the pulleys in the same position as the rubber belt. Is the trouble with the shafting? A. Since your rubber belt ran properly, the shafts must be right; hence a wider leather belt will remove your difficulty.

(17) I. H. S. says: I have had lightning rods placed on my house this spring, but I am doubtful if they have been properly put on or not. They are galvanized, are run up about four feet above the chimneys, one on each end of the house, and run along the ridge of the roof, joining in the center, thence down the roof on to a back kitchen, when another branch joins on from the kitchen chimney, and all run down to about 4½ feet in the ground, which the person who put them up says is sufficient, as the ground is only about 8 or 10 feet above the level of Lake St. Louis. I would like to know if it is proper to have the rods laid on to the shingles, as has been done, and merely fastened on with tacks and strips of zinc. Is a galvanized conductor as good as a copper one? A. Iron has only about one fifth the conducting power of copper. The value of the rod depends upon its size. If it has a diameter of half an inch, it will answer. There ought to be several conductors leading into the earth. Four and a half feet is not sufficient for a ground. You should dig down until you reach water, then dig several lateral trenches, say 10 feet in length, lay down in them iron bars or rods, the larger the better, and connect all your rods to them. Your rods should be welded together so as to leave no bad joints. There is no objection to nailing the rods to the woodwork or shingles.

(18) F. E. N. says: Has not atmospheric electricity small quantity with great intensity? A. Atmospheric electricity may possess both great quantity and great intensity.

(19) I. V. R. says: In No. 17, vol. 1, of your SUPPLEMENT I noticed an article in relation to the increase of the spark of an induction coil. I have a very fine six inch coil made mostly from instructions which you have from time to time published in the SCIENTIFIC AMERICAN, and upon which I tried the following experiment without any result: I attached one end of a copper wire to the street water pipes, and the other to one of the secondary poles of the coil; and the spark remained in every respect as before. Judging from the article above referred to, I should have obtained a lengthening and strengthening of the spark. Did I work correctly or not? A. You should touch the two ends of your induction coil wires together to get a spark.

(20) W. D. E. asks: 1. How powerful a battery would it require to light 100 gas jets at an average distance of 100 feet from the battery? A. Use 100 cells of the gravity battery, or 75 cells Leclanché. 2. What would be the original cost of battery, and what the cost of keeping in operation? A. The cost would be about $150. The cost of maintenance would be small.

(21) A. N. H. says: I have erected a private telegraph line (stove pipe wire, painted and well insulated) 800 feet in length, having a sounder and relay at each extremity, and wish to connect another set about midway, without local battery. I have applied five cells of Daniell's battery at one end of line, and one cell Watt's battery (electroplating) at the other; but I do not get as strong a current to operate instruments as I desire. How many cells should operate said line? A. A greater number of cells will be required to work a line 800 feet in length if the earth is used for a return than if a wire is used to complete the circuit. 2. If I place different kinds of batteries in the circuit, having unequal dynamical power, will they not unitedly give a steady electrical force, in whatever juxtaposition the cells are placed in line of battery, provided the anodes and cathodes are properly arranged? A. You can use different kinds of battery cells upon one wire without difficulty. 3. Please give a definite idea of one ohm of electrical resistance, or actual power of said unit of measure. A. An ohm is equal to the electrical resistance of about 400 feet of the best quality of No. 8 iron wire.

(22) J. R. C. says: I have read of a telegraph by which it is possible to send and receive two messages at the same time, over the same wire, without either message interfering with the other. Can you help me to find out the particulars of the experiments above referred to? A. The Western Union Company are extensively using apparatus by which four messages are simultaneously transmitted over one wire. See p. 151, vol. 33.

(23) G. L. B. asks: What can I put on a brass plate so that the fingers and the damp air will not tarnish it? A. Try lacquer.

(24) C. S. P. asks: What shape of stationary cutter should I use to turn wood in a lathe, so as not to tear the wood? A. A flat cutter made with a lip on the top face, with a keen edge, will answer your purpose.

(25) G. A. M. asks: Can a person in a very deep well see stars in the daytime? A. Yes, if the atmosphere is clear. 2. If so, why? A. Because the light reflected from the surrounding objects on the earth is cut off, and there is not light enough reflected from a column of clear air, of the size of the well, to obliterate the light of the larger stars.

On Thursday in America, what day is it in Europe? A. It will be Thursday also, at any time before about 6 o'clock P. M., Washington civil time. The day changes at every place at midnight.

(26) J. B. says: I cannot give my crayon drawings a fine finish, and wish to know what paper is best. A. We believe your trouble is in the paper. To make smooth drawings, the paper should have a close body with a very fine tooth. Bold effects (to be examined only at a distance) may be made on the coarser paper.

(27) V. M. D. asks: Is cow hair used for any purposes other than for plaster? A. Yes; it is made up into cloths.

(28) A. L. L. says: 1. What is gelatin of which magnetic fish are made? A. It is refined glue. 2. What is the process by which the fish are made? A. By stamping from sheets that have already been rolled to the proper thickness.

(29) J. F. & J. G. say: What causes hair to turn gray in young persons? A. It may be congenital or accidental, depending upon some constitutional peculiarity in the organization of the individual; causes which have been observed to produce it are mental emotion, disease, and injuries. Grief and terror have been known to cause it, varying in time from a few hours to years. Bichat says: "The different passions of the mind have a remarkable influence over the internal structure of the hair; often, in a short period of time, grief effects changes in its color, bleaching the hair, probably by means of absorption of the fluids contained in its tissues." The treatment is to re-

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move the causes of the debility existing in the constitution by tonics, especially chalybeates and phosphoric acid, and (where defective nutritive power prevails) by means of preparations of iron and arsenic, and to stimulate the skin locally by abundant brushing and some gentle stimulant, such as cologne and *aqua ammonia* used at the same time.

(30) H. L. H. says: What will make a cheap jet composition, such as is used for making cheap jet ornaments, which can be worked at the heat of an ordinary fire? A. We believe the materials that have been employed for this purpose are pure asphalt, plumbago or animal charcoal, and gutta percha.

(31) J. S. W. says: I have two rain water cisterns, the water of which is quite offensive. Can any solution be introduced in the cisterns which will correct it? A. Try the remedy recommended to I. E. S., on this page.

(32) W. F. B. asks: On p. 268, vol. 33, you give a formula for writing ink. What is the best process by which to prepare this ink? A. Digest the crushed galls with a portion of the water (hot) for about 48 hours. Then add by degrees the sulphate of iron in a fine powder, with constant agitation until completely dissolved. When this is effected, gradually add the sulphate of indigo, with continued agitation, and allow to cool. Dissolve the gum in the remaining portion of the water (cold), add this solution to the former, stir well, and allow to stand in closed vessels for several weeks. Finally, filter through a bag of fine muslin, and bottle. The ink improves by age.

(33) S. W. asks: Will carbonic cid gas injure the color of fabrics of silk, cotton, and wool, and rust metals? A. No; but in the presence of moisture and carbonic acid, some of the metals rust very rapidly.

(34) J. E. S. says: I have a rain water cistern 12 feet deep; it holds water well, and, so far as the cistern is concerned, there is no imperfection. The water at this time of year becomes putrified, having a slimy look and taste: it emits a scent and has the taste of water in which there are dead animals. Can you tell me a remedy? A. Try the addition of a bushel or two of well burnt charcoal in coarse powder.

(35) J. S. says: I am using raw beef hides for covering saddle trees, and use chrome yellow to get a beautiful color, but do not get it perfect. How can I get the hide perfectly transparent, to have the yellow show through? A. This is impossible.

(36) B. S. C. asks: Is there any chemical process that will turn the hair gray? A. Frequent washing of the hair with a diluted mixture of strong nitric and muriatic acids will accomplish this result. The proportions should be about 1 part of nitric and 3 parts hydrochloric acids, and 20 or 30 parts warm water. The nitric acid will stain the flesh slightly yellow, but this is not permanent.

(37) C. B. M. asks: How can I make asbestos waterproof, and not liable to rot, if placed 3 or 4 feet underground? A. Asbestos is waterproof, and is not liable to decay or rot under either of the conditions mentioned.

(38) W. S. M. says: I have seen a small blood tester, with a ball at one end and a glass cylinder at the other. In this cylinder, there is a lemon-colored liquid with a little glass figure (hollow) in it. If the blood is very warm and feverish, you can keep this liquid bubbling, and this keeps the figure up. Please explain this. A. The liquid is probably ether, and the bulb and cylinder is filled with the ethereal vapor, the air having been completely expelled. The boiling point of ether being very low, the heat of the hand is sufficient, under these circumstances, to cause ebullition; and the increased tension thereby caused in the bulb grasped in the hand causes the liquid to move from bulb into cylinder.

(39) J. M. S. asks: 1. What are the proportions of elements in champagne? A. Analysis of genuine champagne, of specific gravity 10·341 at 60° Fah., gives the following: Absolute alcohol 7·95, sugar 10·63, total acidity 0·52, potash 0·05, water 80·85; total, 100. 2. How are liquids clarified? A. As a general rule, heat to about 170° Fah., filter, and bottle.

(40) C. J. D. asks: Which can be seen the further, a white or red light? A. A white one.

(41) W. S. G. says: 1. Your recipe for marine glue gives 1 lb. glue to 2 quarts skimmed milk. I find the following difficulties: 1. Small white specks through it after cooling. 2. It molds if exposed to the air. 3. It dries or sets very slowly. I made it in an earthen vessel in a water bath, using the best white glue, and as fresh skimmed milk as I could obtain. Can you help me? A. Filter the milk just before using, and add a little alcohol or spirits of wine. 2. What is acid chromate of lime? A. It is a combination of lime with two equivalents of chromic acid. 3. When a recipe calls for parts, and there are liquids and solids mentioned, what am I to understand? A. They are parts by weight.

(42) J. B. asks: Is there any alloy which melts at about 1,000°, suitable for the cylinder of a toy engine? A. Try the following: Melt together 4½ lbs. tin, and ½ lb. each bismuth, antimony, and lead.

(43) J. S. asks: Please describe the process of clarifying raw beef hides? A. When the hides are received fresh from the slaughterhouse, they are washed, if water be abundant, and the horns are removed. Dried or salted hides are soaked in water for 10 or 14 days, with occasional friction; and in some cases a kind of fulling mill is used to produce the soft, supple condition which is necessary for the working. After the washing, green hides are worked with a knife on the flesh side, to get rid of the flesh and fatty matters. The next operation is to get rid of the hair and scarf skin, for which purpose the hides are put into troughs or pits containing a mixture of lime and water, of three or four different strengths in the different pits. They are left for a day or two in the weakest, and then transferred to the others in succession, until, in the course of two or three weeks, depending upon the texture of the hide and the state of the atmosphere, the lime has dissolved the hair sheath, and combined with the fat of the hide to form an insoluble soap. During the operation the hides are handled, or removed from the pits, and allowed to drain in a heap for several hours every day, in order to equalize the action of the lime. When the hair and epidermis yield to the touch, the skins are taken out and scraped upon a cylindrical table with a suitable knife, called the unhairing knife. The remaining flesh and fat are then completely removed from the flesh side of the skin; they are washed with water, and are then ready for tanning.

(44) F. D. says: I have attempted to coat wax figures with copper, by first giving them a good coating of plumbago; but when I lower them into the copper solution, the greater part of the the plumbago comes off. Please describe a remedy. A. When you have coated the figures with a fine even covering of plumbago, gently heat the surface.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

A. J. W.—No. 1 is quartz rock with silicate of alumina. No. 2 is quartzite with oxide of iron. No. 3 is carbonate of copper. No. 4 is clay and decomposed m ca. No. 5 is quartz with clay and oxide of iron. No. 6 is quartz, iron, and lead, no silver. —M. M. S.—It is probably a variety of web resembling that of the spider. If it could be collected in any considerable quantity, there would be little difficulty in soon making a market for it.—R. L. They are sulphides of iron and copper.—J. F. M. E. —It is a variety of steatite, a kind of soapstone. —N. W. E.—No. 1 is a silicious clay containing a small percentage of lime and magnesia. No. 2 has some red ocher; but you must have more of it and a softer rock to be of use. No. 3 is a basalt. It contains some iron, but it could not be profitably extracted.

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On Baling Cotton. By J. G. T.
On the Mississippi River. By J. S.
On the Financial Problem. By J. G.
On Ventilation. By W. M.

Also inquiries and answers from the following:

J. J.—J. H. R.—A. P. B.—J. McB.—F. W. S.—J. K.—J. C. W.—W. B. A.—B. L.—J. B. D.—J. M.—M. B.—T. W.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of inquiries analogous to the following are sent: "Who sells bicycle wheels? Who sells telescope eyepieces? Whose is the best student's microscope? Who sells microscopic objects, mounted? Who makes the best chronometers?" All such personal inquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending,

May 9, 1876,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list, including both the specifications and drawings, will be furnished from this office for one dollar. In ordering, please state the number and date of the patent desired, and remit to Munn & Co., 37 Park Row, New York city.

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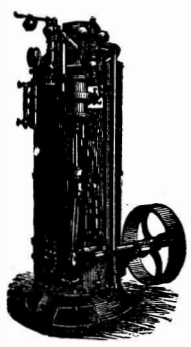
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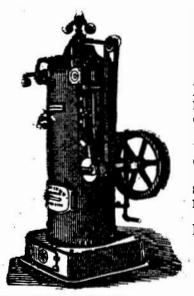
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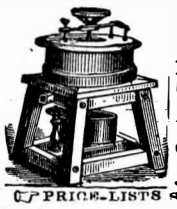
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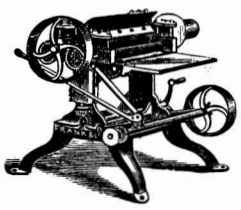
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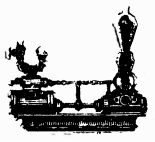
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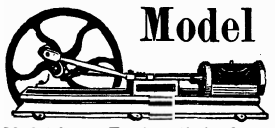
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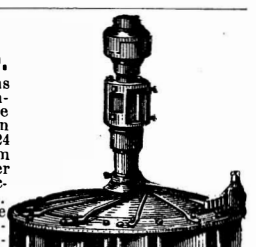

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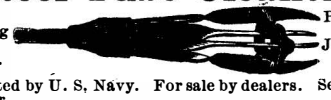

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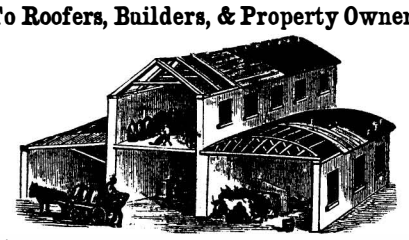

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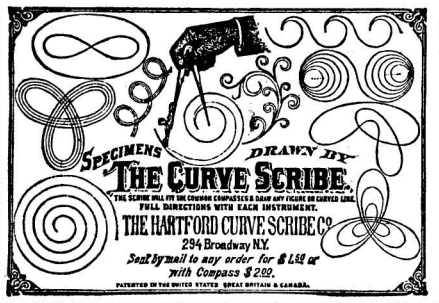
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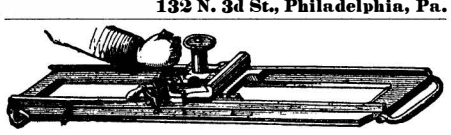

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